PRODUCTIVITY IN THE AMERICAN ECONOMY, 1982

HEARINGS

BEFORE THE

SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY

OF THE

COMMITTEE ON LABOR AND HUMAN RESOURCES

UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

SECOND SESSION

ON

EXAMINATION ON HOW TO ENHANCE PRODUCTIVITY IN THE AMERICAN ECONOMY, THE CAUSE FOR THE DECLINE, AND WHAT ROLE SHOULD THE CONGRESS TAKE

MARCH 19 AND 26; APRIL 2 AND 16, 1982

Printed for the use of the Committee on Labor and Human Resources

U.S. GOVERNMENT PRINTING OFFICE
93-761 O WASHINGTON : 1982

5541-55

COMMITTEE ON LABOR AND HUMAN RESOURCES

ORRIN G. HATCH, Utah, *Chairman*

ROBERT T. STAFFORD, Vermont
DAN QUAYLE, Indiana
PAULA HAWKINS, Florida
DON NICKLES, Oklahoma
LOWELL P. WEICKER, Jr., Connecticut
GORDON J. HUMPHREY, New Hampshire
JEREMIAH DENTON, Alabama
JOHN P. EAST, North Carolina

EDWARD M. KENNEDY, Massachusetts
JENNINGS RANDOLPH, West Virginia
CLAIBORNE PELL, Rhode Island
THOMAS F. EAGLETON, Missouri
DONALD W. RIEGLE, Jr., Michigan
HOWARD M. METZENBAUM, Ohio
——— ———, ———

George W. Pritts, Jr., *Chief Counsel*
Renn M. Patch, *Staff Director and General Counsel*
Lawrence C. Horowitz, M.D., *Minority Staff Director*

Subcommittee on Employment and Productivity

DAN QUAYLE, Indiana, *Chairman*

PAULA HAWKINS, Florida
DON NICKLES, Oklahoma
ORRIN G. HATCH, Utah

HOWARD M. METZENBAUM, Ohio
CLAIBORNE PELL, Rhode Island
DONALD W. RIEGLE, Jr., Michigan
EDWARD M. KENNEDY, Massachusetts
(Ex Officio)

Robert M. Guttman, *Counsel*
Luther Washington, *Minority Professional Staff Member*

CONTENTS

CHRONOLOGICAL LIST OF WITNESSES

Friday, March 19, 1982

Page

Crandall, Robert W., senior fellow, the Brookings Institution; Donald Barnett, vice president and chief economist, American Iron & Steel Institute; and Joel S. Hirschhorn, project director, Office of Technology Assessment 2

Dallob, David L., staff vice president for operations development, Sperry Corp.; M. Eugene Merchant, principal scientist, Cincinnati Milacron; G. Edward Schuh, professor and head, Department of Agricultural and Applied Economics, University of Minnesota; and E. G. Davis, vice president, corporate affairs, Eli Lilly & Co., accompanied by John Virts, senior corporate economist, Eli Lilly & Co 67

Friday, March 26, 1982

Ansell, George S., dean, School of Engineering, Rensselaer Polytechnic Institute, Troy, N.Y.; Jae Edmonds, senior economist, Institute for Energy Analysis, Washington, D.C.; and David A. Jackson, vice president and chief scientific officer, Genex Corp., Gaithersburg, Md 166

Straw, Ronnie J., director of development and research department, Communications Workers of America, Washington, D.C.; David L. Birch, director, MIT Program on Neighborhood and Regional Change, Massachusetts Institute of Technology; Ronald E. Kutscher, Assistant Commissioner, Office of Economic Growth and Employment Projections, Bureau of Labor Statistics; and Alan Fechter, Director, Scientific and Technical Personnel Studies, National Science Foundation, a panel 243

Friday, April 2, 1982

Rees, Albert, president, Alfred P. Sloan Foundation; and Frank M. Gollop, associate professor, Boston College, Chestnut Hill, Mass 356

Baumol, William J., professor of economics, Princeton and New York Universities, and project director, forthcoming policy statement on "Productivity Policy: Key to the Nation's Future" for Committee for Economic Development; and J. R. Norsworthy, Chief, Division of Productivity Research, Office of Productivity and Technology, Bureau of Labor Statistics, U.S. Department of Labor 384

Arai, Joji, manager, Japan Productivity Council, Washington, D.C.; Robert Cowie, vice president, public affairs, Dana Corp., Toledo, Ohio; and Robert Utt, associate chief economist for economic policy, U.S. Chamber of Commerce, accompanied by John Volpe, associate chief economist and director, Trends and Perspective Center, a panel 431

Friday, April 16, 1982

Baxter, William F., Assistant Attorney General, Antitrust Division, U.S. Department of Justice 473

Shapiro, Robert B., vice president and general counsel, G. D. Searle & Co.; Rudolph G. Penner, American Enterprise Institute; and Michael J. Boskin, professor of economics, Stanford University 498

Page

Rose, Michael D., president and chief executive officer, Holiday Inns, Inc.; Alan K. Campbell, executive vice president, management and public affairs, ARA Services, Inc.; and Elmer B. Staats 551

STATEMENTS

American Iron & Steel Institute, Donald F. Barnett, Ph. D., vice president and chief economist, prepared statement 18

Ansell, George S., dean, School of Engineering, Rensselaer Polytechnic Institute, Troy, N.Y.; Jae Edmonds, senior economist, Institute for Energy Analysis, Washington, D.C.; and David A. Jackson, vice president and chief scientific officer, Genex Corp. Gaithersburg, Md 166

Prepared statement 171

Arai, Joji, manager, Japan Productivity Council, Washington, D.C.; Robert Cowie, vice president, public affairs, Dana Corp., Toledo, Ohio; and Robert Utt, associate chief economist for economic policy, U.S. Chamber of Commerce, accompanied by John Volpe, associate chief economist and director, Trends and Perspective Center, a panel 431

Baumol, William J., professor of economics, Princeton and New York Universities, and Project Director, forthcoming policy statement on "Productivity Policy: Key to the Nation's Future" for Committee for Economic Development; and J. R. Norsworthy, Chief, Division of Productivity Research, Office of Productivity and Technology, Bureau of Labor Statistics, U.S. Department of Labor 384

Prepared Statement 389

Baxter, William F., Assistant Attorney General, Antitrust Division, U.S. Department of Justice 473

Prepared statement 478

Birch, David L., director, MIT Program on Neighborhood and Regional Change, prepared statement 303

Boskin, Michael J., professor of economics, Stanford University, prepared statement 533

Campbell, Alan K., executive vice president, management and public affairs, ARA Services, Inc., prepared statement 584

Chamber of Commerce of the United States, Dr. Ronald D. Utt and Dr. John Volpe, on behalf of, joint prepared statement 444

Crandall, Robert W., senior fellow, the Brookings Institution; Donald Barnett, vice president and chief economist, American Iron & Steel Institute; and Joel S. Hirschhorn, project director, Office of Technology Assessment 2

Prepared statement 6

Dallob, David L., staff vice president for operations development, Sperry Corp.; M. Eugene Merchant, principal scientist, Cincinnati Milacron; G. Edward Schuh, professor and head, Department of Agricultural and Applied Economics, University of Minnesota; and E. G. Davis, vice president, corporate affairs, Eli Lilly & Co., accompanied by John Virts, senior corporate economist, Eli Lilly & Co. 67

Prepared statement 72

Eli Lilly & Co., Edgar G. Davis, vice president, corporate affairs, prepared statement 112

Fechter, Alan, Director, Scientific and Technical Personnel Studies, National Science Foundation, prepared statement 340

Gollop, Frank M., associate professor, Boston College, Chestnut Hill, Mass., prepared statement 365

Hirschhorn, Joel S., Project Director, Office of Technology Assessment, prepared statement 48

Jackson, David A., Ph. D., vice president and chief scientific officer, Genex Corp., prepared statement 227

Kutscher, Ronald E., Assistant Commissioner, Office of Economic Growth and Employment Projections, Bureau of Labor Statistics, prepared statement 321

Merchant, Dr. M. Eugene, principal scientist (manufacturing research), Cincinnati Milacron, Inc., prepared statement 97

Norsworthy, J. R., Chief, Division of Productivity Research, Office of Productivity and Technology, Bureau of Labor Statistics, prepared statement 412

Penner, Rudolph G., American Enterprise Institute, prepared statement 514

Rees, Albert, president, Alfred P. Sloan Foundation; and Frank M. Gollop, associate professor, Boston College, Chestnut Hill, Mass 356

Page

Rose, Michael D., president and chief executive officer, Holiday Inns, Inc.; Alan K. Campbell. executive vice president, management and public affairs, ARA Services, Inc.; and Elmer B. Staats 551
  Prepared statement 555
Schuh, G. Edward, professor and head, Department of Agricultural and Applied Economics, University of Minnesota, prepared statement 143
Shapiro, Robert B., vice president and general counsel, G. D. Searle & Co.; Rudolph G. Penner, American Enterprise Institute; and Michael J. Boskin, professor of economics, Stanford University 498
  Prepared statement 503
Statts, Elmer B., member, board of directors, American Productivity Center, prepared statement 604
Straw, Ronnie J., director of development and research department, Communications Workers of America, Washington, D.C.; David L. Birch, director, MIT Program on Neighborhood and Regional Change, Massachusetts Institute of Technology; Ronald E. Kutscher, Assistant Commissioner, Office of Economic Growth and Employment Projections, Bureau of Labor Statistics; and Alan Fechter, Director, Scientific and Technical Personnel Studies, National Science Foundation, a panel 243
  Prepared statement 248

ADDITIONAL INFORMATION

Articles, publications, etc.:

  Economic Policy to the 43rd Annual Convention, statement on 273
  Future Role of Manufacturing and Service-Type Industries in the Economy: Implications for Productivity Policy, the, by Kenneth McLennan, vice president and director of industrial studies, Committee for Economic Development 629
  Simplications for the Communications Workers of America of Technological Change at the Bell System, executive report, by Peter Chinloy, May 1981 258
  Supply of Energy and U.S. Labor Productivity to 1990, by Jae Edmonds and John Reilly, March 26, 1982 197

Selected charts:

  Aggregate U.S. labor productivity and contributions by energy sectors, 1977 219
  Energy sector productivity: 1963-77 220
  Labor productivity in the aggregate economy and energy sectors, 1977 218
  U.S. crude productivity: 1870 through 1980 217
  U.S. energy supply, 1980 and 2000 221

PRODUCTIVITY IN THE AMERICAN ECONOMY, 1982

FRIDAY, MARCH 19, 1982

U.S. SENATE,
SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY
OF THE COMMITTEE ON LABOR AND HUMAN RESOURCES,
Washington, D.C.

The subcommittee met, pursuant to notice, in room 4232, Dirksen Senate Office Building, commencing at 9:30 a.m., Senator Dan Quayle (chairman of the subcommittee) presiding.

Present: Senator Quayle.

OPENING STATEMENT OF SENATOR QUAYLE

Senator QUAYLE. The committee will come to order.

Today is the beginning of a series of hearings that will total 4 days on the issue of productivity.

The word "productivity" has a different meaning, a different connotation, to a lot of different people. The one thing I believe that we can agree on, at least according to polling data, is, in fact, the word "productivity" is no longer a dirty word. It used to be that you mention "productivity" and it was reflective of the Charlie Chaplin's classic movie "Modern Times," where the worker would work harder and sweat more and the only one that benefited from it was the company.

Well, today you mention the word "productivity" and not only does management perk up, but labor perks up; the worker perks up, because they seem to take that word and to correlate it to quality of life, and that if we are more productive and our productivity increases, the better we are going to be, all of us.

There seems to be many different responses on how we can enhance productivity: better tax structure; less regulation; better management-labor relations; more commitment to research and development. There are various responses.

I suppose as the hearings go on a couple of questions that I will have: First of all, what is the major cause in the decline in productivity, whether it happens to be in the steel industry or other industries in general? And, second, what is the role of Congress?

Some of my friends, when they look at productivity, they tell me: Well, just do not do anything. You are doing too much already.

I suppose that is one aspect. Another aspect will be taxes, regulation, patents, et cetera.

But I am having these hearings to put together perhaps the most substantive document that the Congress has yet produced on the issue of productivity.

We will have 4 days of hearings. We have a number of outstanding witnesses. It will be through your testimony and your contribution that we will be compiling a report and will be issuing it and continuing the discussion on productivity.

So, with that, our first panel this morning are three distinguished members. From the Brookings Institution, Robert Crandall; from the American Iron & Steel Institute, Donald Barnett; and from the Office of Technology Assessment, Joel Hirschhorn.

We will go in the order on the list and begin with Mr. Crandall.

STATEMENTS OF ROBERT W. CRANDALL, SENIOR FELLOW, THE BROOKINGS INSTITUTION; DONALD BARNETT, VICE PRESIDENT AND CHIEF ECONOMIST, AMERICAN IRON & STEEL INSTITUTE; AND JOEL S. HIRSCHHORN, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. **Crandall**. Thank you, Mr. Chairman. It is a pleasure to be here.

Let me begin by saying that I come here expressing my own views and not necessarily those of the Brookings Institution or its staff or trustees.

Second, my testimony will derive in large part from a book I wrote on the industry which Brookings published last year.

You set the tone for these hearings as being more broadly conceived than just the problems of productivity in the steel industry, but productivity in general.

Let me say from the start that I think that those policies which might enhance productivity in general are to be deduced from general economic conditions and conditions in other industries. One could be seriously misled by trying to look for policies which will enhance productivity in a specific industry such as steel.

For instance, it might be surprising to you that despite their tremendous problems right now, the steel and the auto industries are not industries which have declined even as rapidly as some other sectors in terms of productivity. As a matter of fact, the official measured rates of productivity growth in the automobile industry actually show some acceleration in recent years.

It may be a statistical quirk because of the handling of certain qualitative aspects of the automobile, such as pollution control devices. But, nonetheless, there has not been a collapse of productivity growth in the auto industry, far from it.

Nor has there been a collapse of productivity growth in the steel industry. The steel industry has had low productivity growth for decades and its productivity growth has been below the manufacturing average. And manufacturing actually has had a somewhat better productivity growth record than the overall U.S. economy in recent years.

So, I think in focusing on the steel industry one has to look at rather specific conditions and recent performance to ask whether general economic policies can enhance productivity very much.

My view of the steel industry is that we are losing comparative advantage and, in fact, have been doing that for 20 or 25 years. That is, the industry's fortunes took a rather severe turn in 1958. In 1959, the industry took a very long strike. Since that time there has been very little growth in the industry. It grew slightly during the 1960's, but it ran with substantial excess capacity.

At that time other countries were expanding their steel capacity much more rapidly. As it turns out, the Europeans were expanding very unwisely, but the Japanese were doubling and redoubling capacity every 5 years or so.

It is my feeling that because of the loss of advantage in terms of the price of natural resources and because of generally declining shipping rates over the post-World War II era, the steel industry in the United States has lost comparative advantage to a large number of other countries who will, in fact, be the source of major growth in the industry in the decades ahead.

There has been no new integrated steel plant built in the United States since 1962 when Bethlehem began the Burns Harbor plant. I do not believe that anybody believes that there will be another one built in the foreseeable future—looking out 10 years or so.

The industry is saddled with its old existing plants, most of which are too small, often in bad locations, and by this time having severe problems because of poor layouts. This is because they have been there a long time, have been modified time and time again, disrupting material flows, and cannot possibly operate as efficiently as a new integrated plant where materials flow right in line.

It is interesting to note that the industry's problems did not go away—and as a matter of fact, perhaps even started a turn for the worse in the 1970's—despite the fact that we had a surge in demand in the late 1960's due to the Vietnam war; we had a bout of trade protection starting with the Voluntary Restraint Agreements starting in 1969; we had a devaluation of the dollar at that time; and we had a world steel shortage in 1974.

In the late 1960's we had a surge of investment and then following the 1973–74 period we had another surge of investment.

Despite those two surges in investment, one does not see any dramatic change in the steel industry nor any dramatic change in productivity. And, as a matter of fact, I am unable to find a systematic relationship between that investment and productivity.

Now, that may be because of statistical problems with the data, but it also may be because the industry spread those capital funds around too many suboptimal plants.

I think the recent performance of the industry, let us say since 1977, perhaps begin to confirm that judgment as they are looking to close the less well located and the smaller integrated plants.

But it is useful to note the average size of our integrated plants is less than half the size of an average Japanese plant. The average Japanese plant is probably right at minimum efficient scale for flat rolled carbon steel products.

So, we are substantially below the optimum efficient scale. This means that if we are to even attempt to approach them, we simply have to focus our investments on fewer integrated plants and probably those plants located in the Great Lakes area. Success in that endeavor will depend upon the success of our fabricating industries in that same geographic area.

I now am somewhat concerned about even the future of those fabricating industries because of recent policies toward the steel industry. Let me just review what has happened, say, since the failure of the industry to recovery from the 1975 recession.

In 1977 we began to negotiate the steel trigger prices in order to handle antidumping suits for the industry. And, as a matter of fact, Mr. Barnett and I were involved in that activity at the Council on Wage and Price Stability in 1977.

In 1978 trigger prices went into effect and a new bout of trade protection developed.

Since that time we have passed a revision of the tax law with refundability of tax credits through the leasing provision, which is, of course, of great benefit to the steel industry. We have passed legislation stretching out their environmental outlays.

Yet we do not see any major change in the fate of the industry. If anything, of course, it is going the other way.

We do not see any revival of investment, despite much talk about it. I do not think there will be any surge of investment. I doubt seriously that investment last year will turn out to be as high in real terms as it was in 1975, and certainly not as high as it was in the late 1960's.

Now, in part the problems at present derive from a very weak economic condition in the United States, which, of course, is also replicated elsewhere in the world. The developed economies of the world have been growing very slowly as they attempt to control the inflation which began following the two major oil price shocks.

In addition, given our monetary policy, our exchange rate is extremely high vis-a-vis European currencies, and as a result import-competing industries have been placed in yet further peril. And the surge in imports from Europe derives in large part, I believe, from the rather dramatic change in exchange rates which occurred a little over 1 year ago.

At the present time, therefore, the industry's prospects, short term and even long term, do not look very good.

What is of major concern is that our fabricating industries may not recover fully. It seems to me that the jury is still out on the automobile industry. But there are a large number of industries which use steel which are having difficulty right now. And they all face a price of steel in the United States, which is about $100 per ton and sometimes more than $100 above the price paid by their foreign competitors due to our trade protection.

For a very long time now we have maintained steel prices in the United States substantially above the price in Japan, with one exception. And that was the period in which the dollar depreciated in 1978 and 1979. It cannot be good for demand for steel in the United States to maintain such a high price, something like 25 percent above the world price for steel, and yet that is what we are doing through trade protection.

I would suggest that unless we change that policy we are going to see very slow growth in our steel-consuming industries and even further downward pressure on the domestic steel industry.

If we continue to have a situation of very slow growth of demand, there is very little hope that major modernization investments will look good to steel companies. And as a result there is very little hope that you will see any improvement in productivity growth.

Of course, there could be some improvement in productivity growth from the closing of the least efficient plants and the substitution of the smaller unintegrated so called mini-mills—the Nucor Steel, Georgetown Steel—for the major integrated works. That will offset the sluggish growth of the U.S. industry and the sluggish productivity growth.

But it seems to me that given the number of policy initiatives which we have taken which should benefit the steel industry in the form of tax law and environmental policy, even short term in the trade protection, we do not see any dramatic change and I doubt that we are likely to see any dramatic change any time soon.

Thank you.

[The prepared statement of Mr. Crandall follows:]

Testimony

by

Robert W. Crandall
The Brookings Institution[*]

before the United States Senate Committee on Labor and Human Resources
Subcommittee on Employment and Productivity

It is a pleasure, Mr. Chairman, to appear before this Subcommittee to express my views on the prospects for the steel industry. Unfortunately, my message wil not be a pleasant one, for I fear that there is little which can be done to arrest the slow decline of the steel industry in this country. The low rate of productivity growth in the industry contributes to this decline and is, in part, caused by it, but productivity growth is by no means the most important problem for the industry. Nor is lagging productivity the principal reason for its decline.

---

[*] The views expressed in this statement are the authors' and do not necessarily reflect the views of the officers, trustees, or other staff of the Brookings Institution. Mr. Crandall is a senior fellow in the Economics Studies Program at Brookings.

Labor Productivity and Investment

The steel industry has not been a dynamic, growing industry since the recession of 1958. Because of this lack of growth, new plant facilities have not been required to accommodate demand. And given a relatively low rate of technological progress, older facilities have not been replaced very rapidly. When replacements have been made, they have generally been placed in older, suboptimal scale plants at less than optimal locations. This means that the industry is increasingly left with older plants with poor materials flow which are of less than suboptimal scale. For this reason, progress in reducing labor or energy usage is impeded.

The trend rate of growth in labor productivity for the steel industry has been rather low for more than two decades. Even during the 1950's and 1960's, the annual productivity growth in steel was a full percentage point below that for all manufacturing. (See Table 1.) During the late 1960's and 1970's, steel followed manufacturing down in productivity growth, but the decline was modest. From 1956 through 1965, the trend rate of growth declined by only about one-half of one percent per year. At an average rate of capacity utilization, productivity growth was 1.5 percent per year in 1966-78 after being 2.0 percent per annum in 1956-65.

Surprisingly, the decline occurred precisely as the industry was accelerating its investment rate in 1965-1968. Investment in steel was at its Korean War high in these years. Despite recent rhetoric, the

Table 1. Productivity Growth in Steel, Manufacturing and the Private Nonfarm Business Sector. (1967=100)

Year	Steel	All Manufacturing	Nonfarm Business
1956	86.4	73.5	74.9
1957	84.3	75.0	76.2
1958	77.9	74.6	78.0
1959	87.5	78.1	79.3
1960	82.3	78.8	81.2
1961	84.9	80.7	83.6
1962	89.2	84.5	86.6
1963	93.2	90.4	89.4
1964	97.2	95.2	92.9
1965	101.1	98.2	95.8
1966	103.2	99.7	98.2
1967	100.0	100.0	100.0
1968	103.5	103.6	103.3
1969	104.0	104.9	103.0
1970	101.3	104.5	103.3
1971	106.2	110.4	106.8
1972	112.7	116.0	110.8
1973	123.5	119.4	113.6
1974	123.5	112.8	110.9
1975	107.6	116.3	113.2
1976	114.5	124.2	116.9
1977	115.6	126.9	119.1
1978	120.7	128.0	118.9
Average Annual Rate of Growth 1956-1978	1.5%	2.5%	2.1%

Source: BLS.

current rate of investment is much lower than this late 1960's rate of reinvestment in steel. It is significant that despite this surge in capital spending, the ensuing trade protection afforded by the Voluntary Restraint Agreements (VRA's) and the devaluation of the dollar, the industry's economic vitality was not restored. Profits rose in 1974 as the world went through a speculative surge in steel buying, but they collapsed in 1975 as inventories were liquidated.

Explaining the Industry's Plight

Comparative advantage. Elsewhere, I have explained the industry's recurrent crises as the result of declining comparative advantage and sharply rising labor rates. With the fall in iron ore prices and shipping rates after 1957 and the increasing dispersion of steelmaking technology throughout the world, other countries began to seize the advantage over the United States in steel production. With labor an important input in production of steel and in the construction of new plants, countries such as Japan (and more recently, Korea, Taiwan and Brazil), have been able to build and operate facilities more cheaply than U.S. companies. For this reason, no new plant has been started in the United States since 1962 and none could have been launched profitably since 1969.

With these dismal growth prospects, the U.S. integrated firms have been forced to maintain old plants, modernize where they can, and husband diminishing resources. The value of all integrated firms' stock began falling in 1958 and has now reached a very low level. At current values, all outstanding common stock for the entire industry is now equal to the value of Marathon Oil (at the price paid by U.S. Steel). The decline in the value of steel equities antedated the general stock market decline by more than ten years, and it has been interrupted only by the false signals which the 1974 steel "shortage" created. Apparently, some Wall Street analysts believed that shortages were becoming a permanent recurring feature of the industry. Those that have purchased steel equities in response to this theory have been sorely disappointed.

Weak world demand. Adding to the U.S. industry's miseries has been the general world-wide weakness in steel demand since 1974 when oil prices were escalated so rapidly. Noncommunist world production has remained generally below its 1974 rate for the entire 1974-82 period while capacity has increased, mostly in the developing world. This has led to continuing downard pressure on world steel prices which Japanese, U.S., and European officials have been trying to suppress since 1977. While these efforts have been partially successful, the relatively low prices and very low profits continue. Europe and the United States continue to face excess capacity and limited prospects for growth in their steel output.

Labor rates. The U.S. industry has allowed its labor rates to escalate to a level which places it in even further distress. With slow labor productivity growth assured, the industry has offered enormous increases in wages and benefits since 1971, the year in which the dollar was devalued and the VRA's became binding. The current industry compensation is nearly $22 per hour. This is more than 75 percent above the average for all manufacturing in the United States. By comparison, European steelmakers pay their workers 10 to 25 percent more than the average industrial worker and the highly-efficient Japanese pay their steelworkers 50 percent more than the average industrial compensation. With these wage rates, U.S. steelmaking costs are much higher than the most efficient plants in Canada, Japan and Europe.

Exchange rates. Finally, the recent strength of the dollar has severely disadvantaged the U.S. industry. At present, the average cost of producing steel in an integrated U.S. plant is substantially above the cost of production in Japan and it may even be higher than the cost of production in the United Kingdom. The Japanese appear to be able to cover costs at less than a 70 percent operating rate with home prices $100 per ton (or 20 percent) below ours. Their competitive advantage is obvious, and it is much greater at 240 yen per dollar than at the 180-190 rate which existed in 1978-79.

Can the Industry Modernize?

Industry officials often argue that with sufficient investment capital, the U.S. industry can modernize and emulate the Japanese industry in terms of efficiency and labor productivity. While there are undoubtedly opportunities for profitable investment at U.S. steel plants, these opportunities are not likely to be sufficient to allow the industry to approach Japanese productivity rates unless many plants are closed. The surge in steel investment which was supposed to occur after the enactment of the Reagan tax and budget proposals in 1981 was largely illusory. At best, it might carry the industry back to the heights reached in the recession year of 1975, but it will not lead to investment at the late 1960's rate.

The reason why investment will not surge in basic steel is obvious. There is a limited amount of capital which can be profitably sunk into the array of suboptimal scale plants in this country. The industry cannot profitably build new ones and it cannot (or at least should not) attempt to modernize all of the old ones. One can only hope that the future investments in this industry turns out better than those in the 1960's and 1970's.

I cannot find a statistical relationship between the capital-labor ratio and labor productivity in the post-1956 period for the steel industry. This means that investment has not generated productivity improvements over the past two decades. While part of the problem may derive from the quality of the data, I believe that much of the difficulty stems from the fact that a sizable proportion of investment was wasted in trying to keep dying plants alive. The number and average size of integrated steel works in the United States has remained virtually constant since the early 1960's, despite the fact that these plants are on average about one half the size required for efficient operation.

The most obvious recent example of a misspent investment was Kaiser's decision to build a large, modern BOF facility at Fontana, California. No integrated steel mill can make sense in the West Coast, yet Kaiser proceeded to invest good money after bad in an attempt to bail out an obsolete plant. The BOF shop was closed just four years after opening, and Kaiser is now selling the plant. National has invested substantial amounts of capital in its Weirton plant, and it is now trying to sell the plant to its workers at an apparently very low price. And Inland Steel is now virtually conceding that its expansion and modernization at an ideal location -- Indiana Harbor on Lake Michigan -- has been a major disappointment.

In short, the prospects are not good for integrated steel manufacturers. They will have to close more plants in the years to come regardless of environmental or steel import policies. With U.S. steel prices substantially above world prices, our fabricating industries will grow much less rapidly than their foreign rivals. Imports will continue to penetrate the U.S. steel market although a decline in the value of the dollar might slow their growth in the next few years. An industry in decline cannot have a very good productivity record. Steel's below-averge performance will not be easily reversed.

Senator QUAYLE. Thank you very much, Mr. Crandall.

Mr. Barnett.

Mr. BARNETT. I am Don Barnett. I represent the American Iron and Steel Institute. This is a trade association which represents 90 percent of the raw steel produced in the United States.

My statement is about labor productivity, but I would like to qualify it by saying that labor productivity is just one aspect of the various productivity measures that one should concern oneself with.

Overall efficiency and cost competiveness depend upon the relationship of the various inputs to output. That is energy efficiency, efficiency of capital as well as labor, and the cost of various inputs.

When we talk about steel, by some measures the American steel industry fares relatively well compared to other steel industry competitors in terms of say capacity utilization and profitability—although not well in either when compared to other U.S. industries.

But in other measures of efficiency, such as energy and labor productivity, the American steel industry is neither the best nor the worst. Normally we do better than let us say the Europeans, but we do worse than the Japanese.

In terms of the other component of costs, input cost, plant costs are more than in Japan, it is about the same as in Europe, less than the Third World. Labor costs are well above those of our competitors, about twice those in Japan, 20 percent above those in West Germany, about 50 percent above Canadian.

So, they are a major disadvantage to American steel producers.

If input costs are high—and with the exception of energy costs because of cheap coal they are—superior efficiency is essential, and, unfortunately, the American steel industry's efficiency has been increasingly insufficient to offset the costs of inputs.

To some extent that is offset by high transport costs from foreign suppliers, so that in the bulk of the American market we are competitive.

Let me turn to the issue of labor productivity, which is of concern.

By absolute standards the American industry compares well with Europe, but does not compare well with either Japan or Canada. We see a possible 20-percent disadvantage compared to Japan and about a 10-percent disadvantage compared to Canada.

Even more disturbing than the abstract disadvantages are the trends. Steel productivity has grown very slowly in the 1970's, less than in the 1960's, and I will come back to that in a minute. But, more importantly, productivity has grown about 1½ percent per year since about 1974 in the United States, as compared to over 3 percent per year in Japan and Europe at actual volume.

Now, if we standardize the volume, the situation gets even worse. It is probably 1½ percent versus say 5 percent overseas, which is not a very happy result.

What are the causes?

Well, we attribute part of the cause to inadequate capital expenditures. What we mean is there is insufficient funds spent on putting in new equipment embodying the latest technology.

This problem in turn results in an inadequate cash flow, which in turn results in low profitability. And in part is due to inadequate past tax policies, let us say, or other government policies.

Part of the problem also is an over allocation of cash to hourly employment costs.

When we have low profitability the concern is greater for American companies than it is say for the Europeans because if they are government subsidized, in most cases the investment goes on anyway, even if they do not have the high profitability.

Limited capital formation has been a concern not only of the U.S. steel industry, but to many U.S. industries. As I said, it in part reflects tax problems, but also reflects an attitude of too little savings and too little investment. For too long American industry has rested—certainly this was true in the 1950's and 1960's—on the absolute advantage it had in terms of productivity.

One other problem and one other reason for the problem of inadequate productivity improvement is, in my view, less direct concern in the United States with productivity as such. We tend to, as companies and as economists and as government, to stress financial performance, overall macroimprovements in productivity so forth. We do not, like the Japanese do, stress what I call the microapproach to productivity: the process by process evaluation of how their performance compares on a company by company basis; setting up work groups, government agencies, to constantly improve that; setting targets and goals. You constantly hear things in Japan, such as "We have achieved the highest yield on plate" or "We have had the highest daily output on blast furnaces" or "We have had the lowest man hours per ton on a slab mill." These types of fact are indicative of what is happening, I believe, in Japan. They are paying very close attention to productivity on a very detailed microbasis. We have tended to do it on a macrobasis.

For some time I have been doing a comparison of the Japanese and the American steel industries on such a basis. I have data for a number of products from 1958 to 1980, but I will concentrate my remarks on one, cold rolled sheet, which is the largest volume item.

For cold-rolled sheet the productivity improvements in Japan between 1958 and 1974 were 9 percent per year. From 1974 to date they were around 3½ percent per year. For the United States it was 2½ percent per year for 1958 to 1974 and 1.2 percent per year thereafter.

The decline after 1974 in part can be attributed to decline in operating rates, but also to the energy crisis, inadequate market performance and lack of investment in modernization which resulted from it.

The productivity improvements in cold-rolled sheet in the United States can be largely associated with changes in a few processes. The switch, for example, from open hearth to BOF was a major benefit to U.S. steel industries in terms of improving productivity. There were steady but nondramatic improvements in all other processes as well.

Now, in contrast in Japan, while much of the productivity improvement can be attributed to a change in major processes, such as larger blast furnaces, switch from open hearth to BOF, continuous casting versus ingot casting, and so on, all of which were dramatic improvements, the fact is that Japanese productivity has been pervasive, every single process, every operating step, and major changes consistently year to year, dramatic improvements, which suggests that they are attacking productivity by collecting the data, analyzing it, evaluating with the Government's help, seeing where they stand, trying to improve, as I said, setting up work groups. They are dealing with productivity by itself. Can we improve productivity? I am talking about labor productivity. The same is true of energy efficiency.

American companies—and I am not talking just about steel, tend to talk about financial performance; rates of return; cost competitiveness. In that kind of environment sometimes productivity becomes an indirect result rather than a direct benefit. Whereas, the Japanese have attacked it head on and this is what is referred to when we talk about the "Demming Method" of evaluating data, collecting it, and so on.

I think a change in approach is useful. The micro approach is useful for evaluating where you are and what you can do.

For example, we can evaluate process by process at a point in time and see—and that is done, by the way, in the paper—how do we compare in the American industry vis-a-vis the Japanese? We can observe that we do very well in basic steel furnace practice; we do well in the finishing operations; we do well in packaging and shipping. But where we do poorly are in coke ovens, blast furnaces, continuous casting.

What can we do about it?

Well, you can install newer, larger coke ovens. That is the reason for the Japanese productivity advantage in this process.

However, we cannot install larger and newer blast furnaces. That can only generally be done by putting in whole new plants. We cannot afford to do that.

Are there more effective ways of doing it?

Yes, there are. There are new techniques which became available since the Japanese put in their facilities, which make it possible to refurbish the existing blast furnances and achieve almost the same results as they did with the new.

We can also move rapidly to continuous casting, and we are doing that.

What I am saying is you can look at, compare and select where it is you are behind.

Now, while that is useful, it is not, of course, a perfect solution because presumably the Japanese are not going to stand still or your competitors are not going to stand still while you are evaluating where you are and what you have to do to catch up.

The Japanese are not trying to catch up. They are the leaders. What they are doing is evaluating where they can go.

I think that is a problem common to much American industry. We tend, or we have let ourselves fall into a catchup position and we cannot catch up as quickly as we would like. What we have to do is sort of leap frog that and say: Now, where can we go to be ahead?

The steel industry believes that it can reassert itself as the main competitive factor in the American market. We do not believe that we can ever be as cost competitive as the Japanese and supply the world market, but then again we did not overbuild capacity to supply the world market either, such as the European producers did.

We believe that with moderate growth and lower labor costs, with stressing our advantages, with emphasizing those products which have a higher value added, by modernizing industry, and, of course, with appropriate policies—and we believe much of those policies are in place—and with due account taken of enforcing the trade laws, that we can become competitive. We know what has to be done, but we have not had the money to do it with.

Short cuts are being taken and ways are being found to use the money we have, but it would be better, and hopefully when the market recovers it will be if more funds were available because all kinds of modernization plans are sitting there waiting—6½ billion dollars' worth are announced—waiting to go ahead, but they have not been accomplished yet.

Thank you.

[The prepared statement of Mr. Barnett follows:]

STATEMENT REGARDING LABOR PRODUCTIVITY AND INTERNATIONAL COMPETITIVENESS IN THE U.S. STEEL INDUSTRY BY DONALD F. BARNETT, PH. D.

Mr. Chairman, and members of the Subcommittee, I am Dr. Donald F. Barnett, Vice President and Chief Economist at the American Iron and Steel Institute. The American Iron and Steel Institute is a trade association of 67 member companies, accounting for 90 percent of the raw steel produced in this country, at steel plants in 39 states and 299 communities throughout this nation. The companies currently employ more than 360,000 workers in their iron and steel operations and have over 800,000 shareholders.

I am also Associate Professor of Economics at the University of Windsor, Ontario, Canada, and have worked as an economist for both the U.S. and Canadian governments on studies of the steel industry and the effects of public policy on that industry.

Since the late1970s, new themes have emerged in the discourse about the performance of the U.S. economy. Whereas post-war economic policy had been dominated by the familiar Keynesian macroeconomic, demand-side aggregates, in recent years there has been increased interest in production and supply. Furthermore, there has been greater concern with the U.S. position in the world economy, especially as regards competitiveness. This is a healthy shift, even if the factors which have produced it have been largely negative: the competitive problems of U.S. basic industries, balance-of payments problems, "stagflation," etc.

One of the themes of this new discourse has been labor productivity. Of course labor productivity is not a new concept; but it is nonetheless true that at times in the past concern with labor productivity tended to focus on its providing a measure of "acceptable" wage increases, i.e., wage increases which would not be inflationary. Here again the emphasis was on macroeconomic concerns; less attention was paid to microeconomic implications, i.e., the implications for firms in specific industries. Now, however, increased attention is being devoted to labor productivity as a significant -- perhaps the most significant -- determinant of international competitiveness.

Before I turn to a discussion of labor productivity in the steel industry, let me offer a few words of caution about overstating the significance of labor productivity. Companies and industries compete directly not in terms of labor productivity but in terms of price and cost. Labor productivity is certainly a prime factor affecting costs, but it is not the whole picture. Even if labor productivity is low, a product can still be competitive if there are compensating cost advantages, e.g., in labor costs. This is the case, for instance, in many developing countries. Alternatively, an investment which raises productivity can actually decrease cost-competitiveness if the capital cost of the investment outweighs the labor savings. Hence improved labor productivity cannot be the ultimate goal in and of itself. Any discussion of international competitiveness in the steel industry must also look at capital efficiency, labor costs, raw materials costs, yield rates, and energy efficiency -- all netted out in the total cost per unit of output.

Table 1 compares the performance of the U.S. steel industry with that of its major competitors in terms of several of the variables which determine overall competitiveness. Here we can see that in terms of capacity utilization, which in effect describes the efficiency of an industry's use of capital, and in terms of profitability, the performance of the U.S. industry has actually been better than that of its major competitors over recent years. Capacity utilization is a key variable here, since it is a prime determinant of profitability. Overall, the U.S. industry has been less devastated than its rivals by the depressed state of the world steel market since 1974, so that it has been able to maintain a comparatively good operating rate. This is due partly to the fact that the U.S. industry has faced the necessity of retiring uncompetitive facilities to a greater extent than its European competitors and partly to the fact that the

TABLE 1

FACTORS AFFECTING COMPETITIVENESS IN THE WORLD STEEL INDUSTRY

	U.S.	Japan	W. Germ.	France	U.K.
Capacity Util. (%)					
1979	87.2[a]	67.4[b]	66.7	71.9[b]	74.6[b]
1980	72.8[a]	69.8	63.5[b]	74.4	44.5
1975-80 avg.	80.4[a]	70.5	62.0	71.8	67.7
Profitability ($/ton shipped)					
1979	27.4	9.4	-14.6	-38.3	-60.9
1980	31.5	42.9	9.4	-43.7	-44.0
1975-80 avg.	12.5	2.9	-17.5	-54.3	-49.0
Energy Efficiency* (mmBTU/ton shpd.)					
1979	36.8	27.1	35.2	37.6	41.2
1980	35.7	27.6	36.6	36.3	39.8
cmpd. ann.rt. of grth., 73-80	.4	1.8	- .5	2.1	- 1.2
Labor Productivity Carbon Steel (mh/tons shipped)					
1979	8.15 8.76[a]	7.09	8.02	10.26	15.67
1980	8.19 8.40[a]	6.72	7.96	9.22	11.15
cmpd ann.rt. of grth., 73-80	1.5 %	7.0 %	3.1 %	6.63%	5.96%

*Data standardized to operating rate of 90% of effective capacity .

Sources: WSC (major carbon producers),
except a) AISI and b) U.N.

U.S. industry has been alone in not over-expanding its capacity in any expectation of being able to dump the output of that excess capacity in any wide-open overseas market, as our offshore competitors have.

Surprisingly, in spite of the poor profit results of the U.S. steel industry relative to the economy as a whole, the U.S. industry has been the most profitable major steel industry in the world. In fact, among major competitors, only the Japanese have been able to make any profit since 1975. Nonetheless, the U.S. industry has been at a severe disadvantage. As a private industry, it is dependent upon competitive financial markets for funds, while most of its foreign counterparts have received major governmental subsidies to permit continued operation -- and in some cases even expansion -- in the face of heavy losses.

Since the energy crisis of 1973, energy costs have gained tremendous importance in the production of steel, now accounting for roughly 20% of total costs. All steelmakers have faced a situation in which immediate efforts to reduce energy usage have been required. Table 1 also shows that U.S. efforts in this regard have been roughly at the international average, so that in terms of energy usage the U.S. industry is outperforming its European competitors as a whole, while the Japanese have a great advantage in this area (at standard volume). This is likely due to the newness of their facilities.

These are several of the factors which affect international competitiveness in the steel industry. I have mentioned them briefly here in order to indicate that an exclusive preoccupation with any one factor can be misleading. Nonetheless trends in labor productivity, which is the final factor described in Table 1, do perhaps play a predominant role, not principally on their own account but also because they are mainly a proxy for capital formation and technological performance. Such factors become increasingly important as the market for raw materials becomes internationalized, eliminating competitive advantages on this front. But while this bolsters the view that labor productivity is a prime determinant of international competitiveness, it is still only part of the picture.

The section on labor productivity in Table 1 cites figures from the American Iron and Steel Institute (AISI) and World Steel Dynamics (WSD), a widely used publication put out by the Wall Street firm Paine Webber Mitchell Hutchins Inc. There is at least one other commonly used steel productivity series, that put out by the Bureau of Labor Statistics. There are several reasons I prefer using the AISI and WSD series -- not least of which is the fact that these series adjust their figures to a standard operating rate, which is the only really valid basis for comparison. I could point out that WSD's figures are very widely used and have been employed instead of the BLS numbers in several of the recent government reports on the steel industry.

Several conclusions emerge from an analysis of the WSD and AISI series. The first is that, at present, the U.S. steel industry is not uncompetitive in terms of the absolute level of labor productivity. The sole exceptions to this are in regard to Japan and Canada, which have a significant advantage (at standard volume) vis-a-vis the U.S. With regard to Europeans, however, we think we are slightly ahead of West Germany, significantly ahead of the French, and far ahead of the British.

The situation is much more disturbing, however, when we compare recent trends in productivity. Using WSD's figures, the compound annual rate of improvement in steel productivity (at standard volume) between 1973 and 1981 were as follows: Japan, 7.0%; France, 6.63%; U.K., 5.96%, West Germany, 3.1%; and U.S. 1.5%. Thus, while the U.S. level of labor productivity at the present time is adequate in most cases to provide the steel industry with a strong competitive foundation, the prognosis is fairly bleak. If the rates of productivity increase found for the period 1973 - 1981 hold true in the future, it will take only seven years until U.S. productivity levels are overtaken by all the countries in this series -- even Great Britian. Given U.S. employment costs, it is simply impossible to exaggerate the negative implications of such a development.

Of course there is a no reason the pattern of the last eight years must be repeated. It is presumably one of the purposes of this hearing to try to define some features of the environment which would ensure that this erosion of competitiveness is halted. To do that, we must define the reasons for the poor productivity performance of recent years.

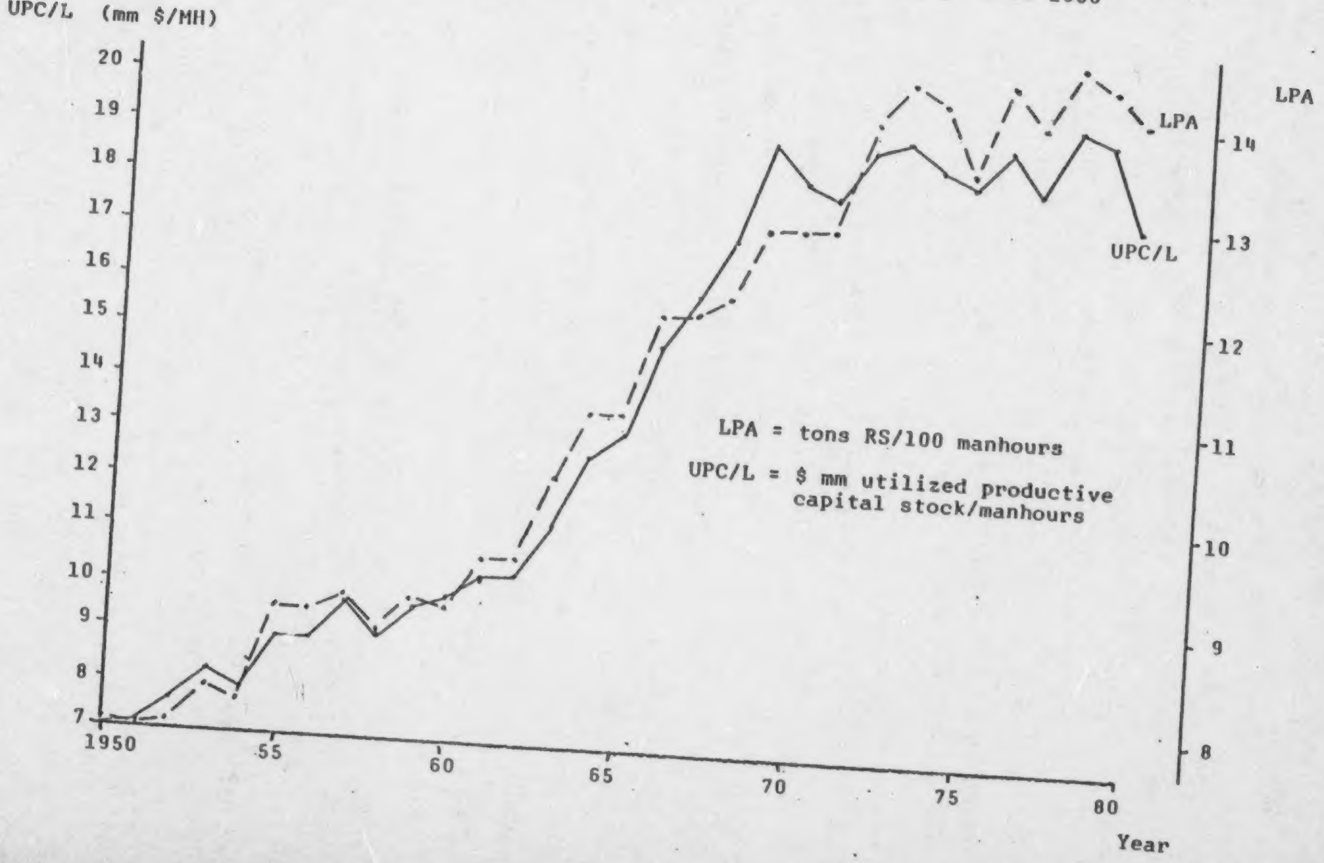
The cause of poor productivity growth through the 1970s in the U.S. steel industry -- and in the U.S. economy as a whole, I might add -- is actually no mystery. Much attention has been devoted lately to questions of management techniques, quality-control circles, and so on. I do not wish to denigrate the potential significance of such improvements, but I would submit that the real problem in steel productivity lies not in subjective factors but in inadequate capital formation. In the final analysis, labor is as productive as the equipment with which it works. In the steel industry, investment through the 1970s has been insufficient to sustain a more rapid increase in productivity. Hence any "solution" to the industry's productivity problems must involve an increase in the funds available for investment.

I have recently done several studies relating labor productivity in the steel industry to capital expenditures and to the capital-labor ratio. What these studies show is a very high correlation between labor productivity and what I call the "utilized productive capital-labor ratio." The qualifying adjectives "utilized" and "productive" are employed to account for variations in capacity utilization and for the fact that much capital expenditure over the past decade has been unproductive in the strict sense. Massive environmental expenditures, for instance, do not increase productivity or efficiency, although they represent substantial capital investment. Figure 1 shows the close relationship between the utilized productive capital-labor ratio and labor productivity. It furthermore shows the flat trend in this ratio in the 1970s (and, unsurprisingly, the flat trend in actual productivity growth). In fact, net productive capital stock in the U.S. steel industry has declined since 1969; capital expenditures in the 1970s were inadequate to maintain -- much less modernize -- existing plant. Given this, what is surprising about the industry's labor productivity record in the 1970s is not that the rate of increase has been so slow but that there has been any increase at all.

While inadequate capital formation explains the poor growth in steel productivity in the 1970s, one must also ask why capital formation has been so inadequate. The answer lies not in a lack of will on the part of the steel industry. In reality, the industry has as a whole invested all or most of the funds its operations could generate. The real culprits are lack of productivity, inadequate cash flow, and over-allocation of steel revenues to hourly employment costs.

Fig. 1

Trends in Capital/Labor Ratios and Labor Productivity 1950-1980



These issues lead us somewhat far afield from the question of labor productivity. It is certainly the case that profits in steel have been inadequate to justify or permit substantial investment in the industry. The rate of return to a dollar invested in steel has been far less than that of a dollar invested elsewhere -- in financial instruments, for instance. As I stated above, however, the rate of return in the U.S. steel industry has exceeded that of every one of its major competitors since the 1973 steel boom. Even the Japanese have earned less than their U.S. counterparts, while losses in Europe have been absolutely staggering. The losses of foreign competitors, however, have been by and large assumed by governments, a factor which has postponed any significant restructuring of the world steel industry and has perpetuated a long-standing crisis of overcapacity, depressed markets, intense price competition, and anemic profits. In spite of massive losses foreign steel firms, subsidized by their governments, have generally been able to maintain fairly high levels of investment -- in most cases far above U.S. levels (see Tables 2 and 3). This explains the descrepancy between the poor performance of profitable U.S. steel firms and the far better performance of effectively bankrupt European firms on the labor-productivity and capital-formation fronts.

TABLE 2

CONSOLIDATED RETURN ON SALES
NET INCOME/SALES (%)
(MAJOR PRODUCERS)

	U.S.	Luxembourg	U.K.	France	Italy	Belgium
1973	4.5	5.3	2.8	1.5	1.9	1.7
1974	6.5	3.5	3.2	1.4	0.9	1.7
1975	4.6	- 3.3	-10.8	-15.9	- 4.0	- 7.9
1976	3.4	- 3.8	- 3.1	-10.7	- 5.9	- 2.6
1977	0.1	-13.4	-14.1	-23.5	-17.6	-13.9
1978	2.5	- 5.1	- 9.4	-14.0	-13.4	-10.2
1979	2.0	- 0.5	-17.6	-10.1	- 8.3	- 2.5
1980	3.0	- 3.5	-22.6	-11.5	-20.4	- 9.4

TABLE 3

STEEL SECTOR CAPITAL OUTLAYS
DEFLATED BY CECI*
DOLLARS/METRIC TON PRODUCED
(MAJOR PRODUCERS)

	U.S.	Luxembourg	U.K.	France	Italy	Belgium
1973	11.1	16.8	28.4	73.6	131.0	15.8
1974	15.2	11.6	41.1	10.0	50.0	25.0
1975	29.6	15.0	60.0	35.6	47.0	23.4
1976	25.5	13.9	38.8	12.3	24.9	15.4
1977	20.7	16.1	35.8	6.6	18.5	11.4
1978	14.6	24.6	22.1	17.0	16.7	7.3
1979	17.4	23.9	24.4	6.0	15.7	10.2
1980	18.6	21.4	18.6	7.4	17.4	17.1

*Capital Expenditure Cost Index developed by WSD

Source: World Steel Dynamics

The capital-formation problems faced by the private U.S. industry in this sort of world environment have certainly been exacerbated by governmental policies. To a great extent, U.S. policies have failed to fully recognize the changed economic conditions of the 1970s, especially the extent to which the U.S. economy is vulnerable to foreign competition. The productivity advantage enjoyed by U.S. industries after World War II provided a very soft cushion for interest groups and policymakers, and we failed to see early enough the dislocations which would threaten once this cushion had been worn away. Thus there was little attention paid to the microeconomic effects, particularly in terms of international competitiveness, of federal policies. As regards the steel industry, this is clearest in terms of tax policy, where until the late 1970s the U.S. steel industry faced a write-off period of 15 years for its equipment, far longer than its competitors (e.g., 1 year in Britain , 2 years in Canada, etc.).

Recent policy changes, not only in terms of taxation but in partial relief from expenditures mandated by federal regulations, have significantly altered the parameters for steel-industry investment. This more favorable environment has led to an approximate doubling of announced investment projects. Roughly 6 billion dollars of capital projects were announced in 1981, a level which more or less corresponds to the industry's own view of the level of investment needed throughout this decade to ensure its vitality.

The more favorable policy changes which we have seen over the last year or so do not in themselves guarantee an improvement in the productivity performance of the steel industry. Several other elements must also be in place, one of which is that there must be advantageous opportunities for investment.

On this point, I am presently in the midst of research comparing U.S. and Japanese steel productivity, by process, from 1955 to present. While this study is not yet complete, I have recently compiled a detailed comparison of man-hour requirements for cold-rolled sheet -- which is a very representative product -- for the year 1977. This type of comparison makes it possible to precisely define the sources of productivity differences and thus to identify the areas in which investment would have the most dramatic effect.

Quite an interesting picture emerges from this comparison. The overall impression is perhaps the most striking. While these figures do show a Japanese advantage, it amounts to only 6% at standard volume (for all products, WSD shows a Japanese advantage of 3.5% for this year). Furthermore, this advantage is far from uniform and does not possess the almost mythological inevitability which often creeps into discussions of the post-war Japanese productivity record.

Table 4 shows the results of this survey in terms of the relative Japanese advantage in specific processes. In most areas (for instance, in actual steelmaking), the U.S. performance is very close to the Japanese. In the packaging and administrative categories, the U.S. has a significant advantage. This advantage is likely to persist, since such processes will be more labor-intensive for an industry which is export-dependent, as is the Japanese. The great bulk of the Japanese advantage lies in three areas: the production of coke, the production of iron in blast furnaces, and the casting of semi-finished shapes. A more detailed analysis of each of these processes can identify the actual prospects of the U.S. steel industry for closing the productivity gap with Japan.

The Japanese advantage in the production of coke (.17 mhpt at standard volume) basically stems from the fact that the Japanese ovens are newer and larger than those in the U.S. In 1979, for instance, the average age of Japanese batteries was about eleven years vs 17 years in the U.S.; the output of Japanese ovens was 23 tons per day vs. 16 in the U.S. The main Japanese productivity improvements in coke ovens appeared in the late 1950s and early 1960s, while the Japanese advantage began to narrow in the late 1970s. This is because U.S. firms,

TABLE 4

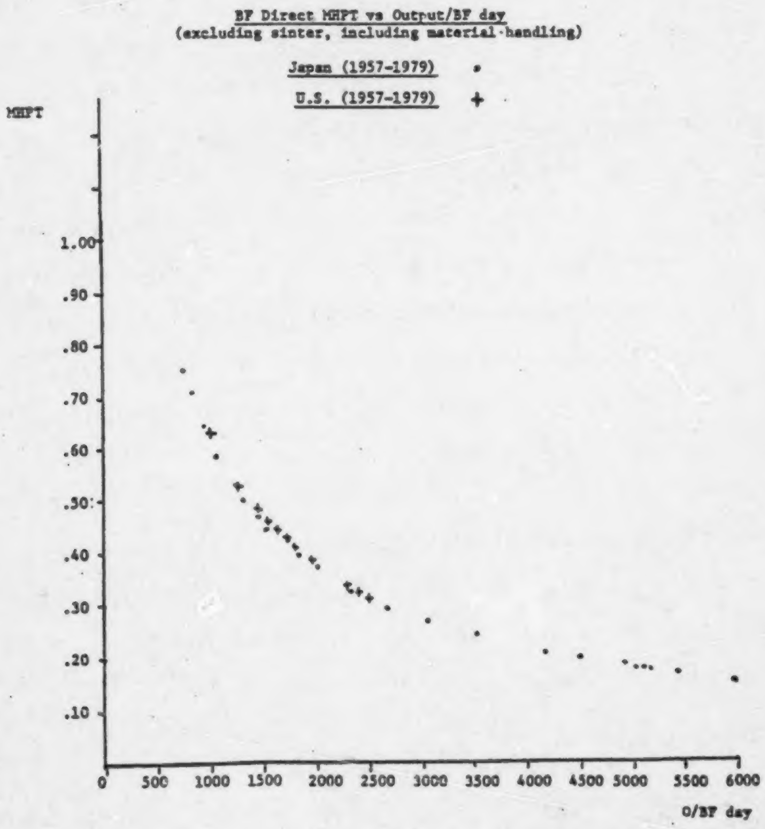
Source of Japanese Advantage Over U.S. in MHPT - 1977 C.R.S.

			Direct	Total
Sinter:		Performance Difference	+.02	+.07
		Use Difference to C.S.	-.04	-.23
Coke Ovens:		Performance Difference	+.20	+.17
		Use Difference C.S.	-	-
Blast Furnaces:		Performance Difference	+.18	+.36
		Use Difference C.S.	-.04	-.11
Scrap Handling:		Performance Difference	-	-
		Use Difference C.S.	-	+.04
BOF:	Melt	Performance Difference	+.10	+.04
		Use Difference	-	-
	I.C.	Performance Difference	-.08	+.01
		Use Difference	+.04	+.07
	C.C.	Performance Difference	+.06	+.07
		Use Difference	-.08	-.16
	Total	Performance Difference	+.08	+.12
		Use Difference	-.04	-.09
Slab:		Performance Difference	-.02	-.03
		Use Difference	+.09	+.16
Hot Rolling:	C & S	Performance Difference	+.06	+.02
	Pickle	Performance Difference	-	-.01
Cold Rolling:	Tandeum	Performance Difference	-.01	-.01
	Anneal	Performance Difference	-.01	-.02
	Temper	Performance Difference	+.07	+.09
Finish:		Performance Difference	+.02	+.02
Package		- other		-.21
Admin.		- other		-.19
Yield:		Performance Difference	+.11	+.33
Total:		Performance Difference	+.70	+1.11
		Use Difference	-.03	-.23
		Other		-.40
		Total	+.67	+.48

possibly because of environmental regulations, have devoted a disproportionate share of capital expenditures to this facility. At the present time, for instance, the average age of U.S. batteries has fallen to less than 16 years (17 in 1979) while the median age is down from 18 in 1979 to only 12 in 1982 (i.e., one-half of present U.S. coke-oven capacity is 12 years old or less). As the age of U.S. batteries falls, their average size increases, so that productivity improves substantially. Hence the U.S. productivity disadvantage in coke ovens is being eliminated fairly rapidly and is expected to narrow in the next few years, an outcome due to both the closure of older facilities and the construction of new ones. While productivity in U.S. coke ovens will likely soon approach the most advanced levels, it should be noted that this has been accompanied by a fairly massive closure of facilities and, concomitantly, the surrender of self-sufficiency in production.

The Japanese advantage in blast furnaces amounts to .36 mhpt at standard volume. Here again, the source of the difference is the fact that through the early '70s the Japanese enjoyed a rapidly growing market and hence were able to construct completely new "greenfield" plants, incorporating state-of-the-art technology. Furthermore, since blast furnaces must be licensed by the Japanese government and since licenses are in effect rationed among producers, there has been an incentive for Japanese firms to build the largest furnaces available. Productivity increases with the size of the blast furnace, and the relationship between these two variables is almost identical for the U.S. and Japan (see Figure 2). Hence the 1977 Japanese

FIGURE 2



productivity advantage in blast furnaces can be ascribed to the fact that in that year the average daily output of the Japanese blast furnace was over 5000 tons, while in the U.S. it was less than 2500 tons.

Nonetheless the data also indicate that the rate at which productivity improves with increased blast furnace size becomes very low after an average of about 4000 tons per day is reached. And when the steel market is depressed, as it has been since 1975, the productivity advantage of a 6000 tpd furnace over a 4000 tpd furnace is swamped by the excess capacity embodied in the larger facility. Adjusting such behemoths to sharp variations in demand is technologically difficult and exceedingly expensive. Hence most analysts would agree that an average daily blast furnace output of 4000 tons is actually economically satisfactory, given considerations of capacity utilization. This figure is within the reach of U.S. firms through retrofitting existing furnaces with more advanced equipment and through the retirement of smaller furnaces (made possible by the increased output of retrofitted furnaces). Thus, the U.S. industry can achieve a substantial narrowing of their blast furnace productivity disadvantage at standard volume without building many new, larger furnaces. The advantages of greater U.S. flexibility in the face of demand changes, due to the smaller average blast furnace size, would be counted in addition to this narrowing of the productivity gap.

Finally, let us look at the U.S. disadvantage in casting. Here the situation is more complex, since we have to describe essentially two processes: the new technology, continuous casting, is gradually replacing the more traditional ingot casting. Further complicating the analysis is the fact that yields are much higher for continuous casting than for ingot casting, a factor which itself increases labor productivity in terms of finished product. Overall, the 1977 Japanese advantage from continuous casting was about 0.5 mhpt (at standard volume), of which 60% stems from higher yields.

This is the most significant source of the overall Japanese advantage. While the U.S. performed impressively installing the major new technology of the 1960s, the basic oxygen furnace, this has not been the case with the installation of continuous casting, the major new technology of the 1970s. To some extent, this has been due to the technological difficulties of implementing this technology in existing plants -- a problem which an expanding industry (like the Japanese) would not face. A second reason for the slow implementation of this technology has been the weak capital expenditures of the 1970s. While the Japanese continuously cast 60% of their steel in 1980, the comparable figure for the U.S. was only 20%.

However, it is also the case that the Japanese are approaching the technological limit of continuous casting, a technology which is not suited to all types of steel products. Hence they have largely exhausted the benefits to be gained from this technology. In the case of the U.S., the major productivity advantages of employing this technology still lie ahead. This potential may represent a plus; in technology, there are often advantages to not being first -- as much of the post-war progress of Japanese industries attests.

The analysis which I have just presented is probably of greater interest to engineers and economists than to policymakers. My purpose in introducing it here has been to show that the Japanese productivity advantages are grounded not in the folklore of national cultures but in the relatively mundane world of objective production techniques and equipment. While pointing this out does not diminish the present Japanese advantage, it does indicate that catching up is essentially a matter of the availability of sufficient resources and their allocation to the proper investments. We do not have to reinvent the wheel.

While this type of analysis identifies the best prospects for investment and indicates that targeted investment could have a substantial impact on productivity, it unfortunately does not guarantee that the investment will take place, nor even that it should take place. This depends upon the effects of investments on costs. For instance, it may well be the case that limited investment funds are better devoted to equipment which increases energy efficiency rather than labor productivity. That has in fact been the case for much steel investment over recent years: since 1972, the energy-efficiency of the steel industry has increased by 10%. Similarly, it is often the case that capital savings may outweigh labor-productivity considerations in determining the investment strategy pursued by the firm. This is certainly the main reason behind the increasing shift to electric furnaces in steel production. Finally, the existence of substantial excess capacity -- besides limiting industry profits -- undermines the attractiveness of investment. While capacity utilization in the U.S. steel industry has in recent years been above that of its international rivals and while U.S. firms have made substantial progress in achieving profitable operation at low levels of capacity utilization, this has not been achieved through the types of investment programs which will significantly improve the industry's productivity performance over the long run.

Some of the elements which could lead to a significant improvement in the industry's productivity record -- especially tax policies which encourage investment -- are now in place. And, as I have described, a realistic potential exists for targeted investment which could have dramatic effects on productivity. Nonetheless significant improvements in the steel industry's productivity record, which depends crucially on investment in more modern facilities, will be very difficult to achieve without some improvement in the overall economic situation and a return to the long-run trend in the growth of the steel market. This brings us back to more macroeconomic factors, the overall rate of GNP growth and the level of interest rates. Interest rates in particular are having a devastating impact on the steel industry. More directly, high domestic rates severely suppress capital investment for the economy as a whole, one of the chief sources of steel demand. Secondly, the increased strength of the dollar due to high U.S. rates has artificially and drastically reduced the price of imported steel, causing further uncertainties for domestic producers. Under such circumstances it is very difficult to justify massive capital spending programs.

It would be misleading to end on such a bleak note. I do think that in the proper environment the steel industry can make substantial progress on the productivity front as well as in other areas. The recent performance of the Canadian industry provides a good example of this potential. In the late 1950s the Canadian industry faced a situation similar to that confronted by the U.S. industry today: Canada was a substantial net importer, profits and productivity were low, and costs were high. Today the Canadian industry, while small, is one of the most profitable and efficient in the world, exporting much of its output. Its situation was reversed due to the enactment of positive government policies (e.g., in taxation and anti-trust) and to a growing domestic market. While this performance might be difficult for the U.S. industry to match (market growth, for instance, will certainly not be as great in the U.S. as it has been in Canada over the last 20 years), there is no reason that a similar set of circumstances could not reverse the fortunes of the U.S. industry to a great extent.

Besides the new tax policies and regulatory relief, there are several less sweeping measures which could be undertaken by government to assist in the improvement of labor productivity in the steel industry. Continuous casting, which I have already cited as the most promising area for investment to raise productivity, provides one example. This technology also offers substantial energy savings: the industry estimates that the transition to continuous casting will save 10% of total steel industry energy usage -- over and above this technology's potential for boosting productivity and product quality. Yet it has not been declared eligible for energy tax credits because of its substantial benefits in areas other than energy conservation. This is a particularly perverse example of official narrowmindedness.

Finally, though, let me stress again that there are probably no radical government initiatives which would in a recessionary period foster the capital investment necessary to significantly boost productivity. Enforcement of the trade laws, however, is necessary. There are several positive factors acting to boost such expenditures once the upswing begins, provided there has been no major erosion of U.S. market share. On the question of international competitiveness, however, I will conclude with the sobering point that even after the present recession is over, the U.S. government must come to grips with what is now the overriding long-run problem faced by the steel industry, one which simply cannot be solved by the private sector alone. I refer to the fact that to a very great extent its competitors in the steel market are no longer foreign industries but foreign governments. So long as foreign industries, particularly those in Europe, can maintain high levels of investment while suffering losses which would bankrupt U.S. firms, there is little prospect for a fundamental reversal in the trend of relative productivity growth which I described at the outset of this paper.

Senator **QUAYLE**. Thank you very much, Mr. Barnett.

Mr. Hirschhorn.

Mr. **HIRSCHHORN**. Mr. Chairman, my statement summarizes the principal findings of OTA's report to Congress on Technology and Steel Industry Competitiveness, which was released in 1980, and of more recent analyses concerning labor productivity in the U.S. steel industry.

The problems of the domestic steel industry are well known to you. Since World War II ended, the U.S. steel industry has declined from a position of world preeminence, high profitability and international competitiveness to an industry that has fallen behind technologically, become less able to serve the needs of other U.S. industries, lost its ability to compete in international markets, become one of the least profitable industries in the Nation, and reduced its work force drastically. In the past two decades, employment in the domestic steel industry has been reduced by over 100,000 people. Moreover, the U.S. share of world steel production has dropped from about 25 percent in the early 1960's to about 15 percent today, as world steel production doubled in this period.

But the issues go further than the total amount of steel produced or the number of workers. It is labor productivity and labor costs which determine, to a very substantial extent, the competitiveness and productivity of our steel industry. The lack of improvement in labor productivity—that is, little reduction in the number of worker hours needed to make a ton of steel—and the large increases in per ton labor costs in recent years have contributed to the decline of our steel industry.

Let me quickly point out, however, that the OTA studies have revealed the need to place increased emphasis on problems associated with the management of steel companies and their decisions regarding the creation and adoption of technological advances. It is too simple to fix the blame on workers and their union. While it is true that the steelworkers union has been successful in obtaining substantial wage increases, it is important to remember that the management of steel firms have acquiesced to those wage increases. Moreover, it would be wrong to conclude that the lack of improvement in labor productivity is due to the unwillingness of workers to produce more efficiently, or to their lack of expertise. There is no evidence to suggest that American steelworkers are inferior to Japanese or West German steelworkers. OTA finds that it is the tools, equipment, and facilities provided American steelworkers that severely constrain and limit the productivity in the domestic steel industry, and that management-labor relations in the U.S. steel industry could be improved.

First I will review how labor productivity in the United States steel industry has declined relative to the performance of the Japanese steel industry, which is now generally considered the world's most efficient major steel industry, and to the West German steel industry, Europe's most efficient major steel industry. Then I will provide some details on the causes for the Japanese and West German success and for the lack of improvement in the United States steel industry.

Less than 10 years ago, labor productivity in the American steel industry was higher than in the Japanese and West German steel industries. For example, in 1972 the number of worker hours to make a ton of steel was 10.61 in the United States, 11.85 in Japan, and 13.44 in West Germany. In 1980, however, the number of hours was 10.34 in the United States, 7.4 in Japan, and 9.85 in West Germany. The Japanese had reduced their hours by 37.5 percent, the West Germans had reduced their hours by 26.7 percent, and the United States with a 2.5-percent decrease had not significantly reduced its hourly needs. If one looks at the data for 1964, one finds that both Japan and West Germany required about twice the hours to make a ton of steel as the United States did. How did Japan and West Germany achieve this spectacular improvement in labor productivity?

A recent OTA analysis has revealed that the improvements in labor productivity in Japan and West Germany are largely a result of two major factors. The first, a major technological advance, is the use of continuous casting to directly convert molten steel to primary ingot shapes for finishing into steel products. The second, and more of an institutional development, was the increasing use of ferrous scrap in electric furnaces to replace primary iron making based on blast furnaces and coke ovens.

Japan increased its use of continuous casting from 17 percent in 1972 to 60 percent in 1980. Contrary to some beliefs, this Japanese adoption has taken place, for the most part, not by building new steel plants, but by replacing existing equipment with continuous casting. During that period West Germany increased continuous casting from 14 percent to 46 percent. What of the U.S. steel industry? In the same period, continuous casting increased from 6 percent to 20 percent. The U.S. steel industry remains substantially behind the world's steel industries in the use of continuous casting, a technology that not only improves labor productivity, but also reduces energy consumption markedly, reduces pollution, improves steel quality, and reduces the amount of waste steel in plant operations.

The use of electric furnace steelmaking was the second most important cause of the dramatic improvement in Japan's and West Germany's labor productivity in steelmaking. In Japan, electric steelmaking increased from nearly 19 percent in 1972 to nearly 25 percent in 1980. For West Germany in this period, the increase was from 10 percent to 15 percent.

A similar increase in the U.S. steel industry is linked to what the OTA report revealed as a remarkable restructuring of the industry due to the rapid emergence of minimills. These minimills are based on the use of ferrous scrap in electric furnaces and are much smaller than the blast furnace based integrated mills. During the past two decades these minimills have increased their share of domestic production from only a few percent to over 15 percent today. The OTA studies project that by 1990 these minimills, with their high productivity and profitability and low capital costs, may account for 25 percent of domestic production. During a period when foreign steel won the competitive battle with U.S. integrated steelmakers, the domestic electric furnace based minimills were so competitive that imports decreased dramatically in those product lines in which the minimills specialized. Moreover, as the minimills have expanded, their products have become more complex and diversified. The growth of the minimills, to a large extent, accounts for the substantial increase in electric furnace steelmaking in the United States, from 18 percent in 1972 to 28 percent in 1980.

What is even more impressive about the improvements in productivity made by Japan and West Germany in recent years is that they took place during a time when the operating rates of the steel industries declined substantially, caused by reductions in world steel demand and sharp increases in steelmaking capacity, particularly in the developing world.

In the United States the operating rate has also declined, but to a far smaller extent than in Japan and West Germany. For the past 10 years the average operating rate in the United States was about 85 percent, but in Japan and West Germany it was closer to 70 percent. And higher operating rates usually lead to more efficient operation. Thus, the importance of the contribution of continuous casting and electric furnace steelmaking to improving labor productivity for Japan and West Germany is even more impressive because it took place during a period of sharply declining operating rates.

But why has not the increase in continuous casting and electric furnace steelmaking in the United States brought about any substantial improvement in our productivity, particularly as our operating rates have been relatively high?

OTA finds that the lack of improvement in labor productivity in domestic steelmaking results from the following factors:

First, the remaining low level of continuous casting usage—only 20 percent—which is a reflection of investment decision made by U.S. steel industry management.

Second, the continued use of those integrated steelmaking plants that are old and inefficient, also a consequence of the investment decisions of U.S. steel industry management.

Third, poor labor-management relations in many integrated steel plants, which is verified by substantial differences in labor productivity among such plants in the United States.

What of the future?

Labor productivity could improve substantially in the U.S. steel industry during the next 10 years and will to some extent with the expected replacement of some integrated steelmaking capacity with new minimill capacity. Some domestic integrated steelmakers are finally making a commitment to greater use of continuous casting. But there are also signs, such as increased diversification out of steelmaking, that the commitment to steelmaking in the future may be weakening and that investments in improved steelmaking technologies, such as continuous casting, may suffer as a result.

From a longer term perspective it is clear that much more attention is needed now on R. & D., adoption of many types of technological advances and plans for several major new, innovative integrated steel plants during the 1990's. Also needed is a major shift in the thinking and attitudes of steel industry management toward using technology as a tool to gain competitive advantage. The irony is that the United States has the physical and human resources, as well as a large domestic market for steel, to support a healthy, profitable steel industry.

Finally, you may note that I have not dealt much with wage rates. It is the hourly wage rate in combination with the hours needed to make 1 ton of steel that leads to the labor costs in steelmaking. Hourly labor costs in the U.S. steel industry have increased dramatically and to a far greater extent in recent years than in almost all other steel industries. Clearly, labor and management need to work together to see that labor-management relations improve and, perhaps more importantly, to insure that more investments are made in innovative technology. It takes considerable time to put new technology in place. Therefore, there is a need for labor to realize that if steel industry management commits itself to self-revitalization, then labor may have to moderate its wage demands until the industry becomes more efficient, competitive, and profitable.

When macroeconomic policies do not adequately deal with the steel industry's problems, OTA has found that the use of a comprehensive sectoral steel policy by the Government might be a useful tool to insure adequate domestic steelmaking capacity for both our peacetime and emergency needs, as well as for a profitable U.S. steel industry that can maintain reasonable employment levels. Our report also emphasized that technology alone will not solve the domestic steel industry's problems, but neither will changes in tax policies, environmental regulations or policies toward steel imports alone be sufficient.

While it is true that there have been unfairly traded steel imports, mostly from Europe, which have recently led to an increase in import penetration and contributed to low domestic operating rates, it would be wrong to conclude that stemming such imports would resolve the U.S. steel industry's problems. Other truly competitive steel industries could, for example, ship more steel here if European sources were blocked. Neither is the cost of environmental regulations in itself a major cause of the industry's problems.

The Japanese have had similar environmental costs and the costs of diversification efforts of U.S. steel companies have exceeded the costs of environmental regulations.

The domestic steel industry has continued to focus attention on solutions that the Government should pursue. However, it is the industry's own decisions, particularly regarding technology, that are a crucial part of the ultimate solution.

Mr. HIRSCHHORN. Thank you.

[The prepared statement of Mr. Hirschhorn follows:]

STATEMENT OF JOEL S. HIRSCHHORN
PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT
BEFORE THE
SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY
COMMITTEE ON LABOR AND HUMAN RESOURCES
UNITED STATES SENATE

MARCH 19, 1982

MR. CHAIRMAN AND SENATORS, MY STATEMENT SUMMARIZES THE PRINCIPAL FINDINGS OF OTA'S REPORT TO CONGRESS ON TECHNOLOGY AND STEEL INDUSTRY COMPETITIVENESS, WHICH WAS RELEASED IN 1980, AND OF MORE RECENT ANALYSES CONCERNING LABOR PRODUCTIVITY IN THE UNITED STATES STEEL INDUSTRY.

THE PROBLEMS OF THE DOMESTIC STEEL INDUSTRY ARE WELL KNOWN TO YOU. SINCE WORLD WAR II ENDED, THE UNITED STATES STEEL INDUSTRY HAS DECLINED FROM A POSITION OF WORLD PREEMINENCE, HIGH PROFITABILITY AND INTERNATIONAL COMPETITIVENESS TO AN INDUSTRY THAT HAS FALLEN BEHIND TECHNOLOGICALLY, BECOME LESS ABLE TO SERVE THE NEEDS OF OTHER UNITED STATES INDUSTRIES, LOST ITS ABILITY TO COMPETE IN INTERNATIONAL MARKETS, BECOME ONE OF THE LEAST PROFITABLE INDUSTRIES IN THE NATION, AND REDUCED ITS WORKFORCE DRASTICALLY. IN THE PAST TWO DECADES, EMPLOYMENT IN THE DOMESTIC STEEL INDUSTRY HAS BEEN REDUCED BY OVER 100,000 PEOPLE.

MOREOVER, THE U.S. SHARE OF WORLD STEEL PRODUCTION HAS DROPPED FROM ABOUT 25 PERCENT IN THE EARLY 1960'S TO ABOUT 15 PERCENT TODAY, AS WORLD STEEL PRODUCTION DOUBLED IN THIS PERIOD.

BUT THE ISSUES GO FURTHER THAN THE TOTAL AMOUNT OF STEEL PRODUCED OR THE NUMBER OF WORKERS. IT IS LABOR PRODUCTIVITY AND LABOR COSTS WHICH DETERMINE, TO A VERY SUBSTANTIAL EXTENT, THE COMPETITIVENESS AND PROFITABILITY OF OUR STEEL INDUSTRY. THE LACK OF IMPROVEMENT IN LABOR PRODUCTIVITY, THAT IS, LITLE REDUCTION IN THE NUMBER OF WORKER HOURS NEEDED TO MAKE A TON OF STEEL, AND THE LARGE INCREASES IN PER TON LABOR COSTS IN RECENT YEARS HAVE CONTRIBUTED TO THE DECLINE OF OUR STEEL INDUSTRY.

LET ME QUICKLY POINT OUT, HOWEVER, THAT THE OTA STUDIES HAVE REVEALED THE NEED TO PLACE INCREASED EMPHASIS ON PROBLEMS ASSOCIATED WITH THE MANAGEMENT OF STEEL COMPANIES AND THEIR DECISIONS REGARDING THE CREATION AND ADOPTION OF TECHNOLOGICAL ADVANCES. IT IS TOO SIMPLE TO FIX THE BLAME ON WORKERS AND THEIR UNION. WHILE IT IS TRUE THAT THE STEELWORKERS UNION HAS BEEN SUCCESSFUL IN OBTAINING SUBSTANTIAL WAGE INCREASES, IT IS IMPORTANT TO REMEMBER THAT THE MANAGEMENT OF STEEL FIRMS HAVE ACQUIESCED TO THOSE WAGE INCREASES. MOREOVER, IT WOULD BE WRONG TO CONCLUDE THAT THE LACK OF IMPROVEMENT IN LABOR PRODUCTIVITY IS DUE TO THE UNWILLINGNESS OF WORKERS TO PRODUCE MORE EFFICIENTLY, OR TO THEIR LACK OF EXPERTISE. THERE IS NO EVIDENCE TO SUGGEST THAT AMERICAN STEEL WORKERS ARE INFERIOR TO JAPANESE OR WEST GERMAN STEEL WORKERS. OTA FINDS THAT IT IS THE TOOLS, EQUIPMENT AND FACILITIES PROVIDED AMERICAN STEELWORKERS THAT SEVERELY CONSTRAIN AND LIMIT THE PRODUCTIVITY IN THE DOMESTIC STEEL

INDUSTRY, AND THAT MANAGEMENT-LAPOR RELATIONS IN THE UNITED STATES STEEL INDUSTRY COULD BE IMPROVED.

FIRST I WILL REVIEW HOW LABOR PRODUCTIVITY IN THE UNITED STATES STEEL INDUSTRY HAS DECLINED RELATIVE TO THE PERFORMANCE OF THE JAPANESE STEEL INDUSTRY WHICH IS NOW GENERALLY CONSIDERED THE WORLD'S MOST EFFICIENT MAJOR STEEL INDUSTRY, AND TO THE WEST GERMAN STEEL INDUSTRY, EUROPE'S MOST EFFICIENT MAJOR STEEL INDUSTRY. THEN I WILL PROVIDE SOME DETAILS ON THE CAUSES FOR THE JAPANESE AND WEST GERMAN SUCCESS AND FOR THE LACK OF IMPROVEMENT IN THE UNITED STATES STEEL INDUSTRY.

LESS THAN TEN YEARS AGO, LABOR PRODUCTIVITY IN THE AMERICAN STEEL INDUSTRY WAS HIGHER THAN IN THE JAPANESE AND WEST GERMAN STEEL INDUSTRIES. FOR EXAMPLE, IN 1972 THE NUMBER OF WORKER HOURS TO MAKE A TON OF STEEL WAS 10.61 IN THE UNITED STATES, 11.85 IN JAPAN AND 13.44 IN WEST GERMANY. IN 1980, HOWEVER, THE NUMBER OF HOURS WAS 10.34 IN THE UNITED STATES, 7.40 IN JAPAN AND 9.85 IN WEST GERMANY. THE JAPANESE HAD REDUCED THEIR HOURS BY 37.5 PERCENT, THE WEST GERMANS HAD REDUCED THEIR HOURS BY 26.7 PERCENT, AND THE UNITED STATES WITH A 2.5 PERCENT DECREASE HAD NOT SIGNIFICANTLY REDUCED ITS HOURLY NEEDS. IF ONE LOOKS AT THE DATA FOR 1964, ONE FINDS THAT BOTH JAPAN AND WEST GERMANY REQUIRED ABOUT TWICE THE HOURS TO MAKE A TON OF STEEL AS THE UNITED STATES DID. HOW DID JAPAN AND WEST GERMANY ACHIEVE THIS SPECTACULAR IMPROVEMENT IN LABOR PRODUCTIVITY?

A RECENT OTA ANALYSIS HAS REVEALED THAT THE IMPROVEMENTS IN LABOR PRODUCTIVITY IN JAPAN AND WEST GERMANY ARE LARGELY A RESULT OF TWO MAJOR FACTORS. THE FIRST, A MAJOR TECHNOLOGICAL ADVANCE, IS THE USE OF CONTINUOUS CASTING TO DIRECTLY CONVERT MOLTEN STEEL TO PRIMARY INGOT SHAPES FOR FINISHING INTO STEEL PRODUCTS. THE SECOND, MORE OF AN INSTITUTIONAL DEVELOPMENT, WAS THE INCREASING USE OF FERROUS SCRAP IN ELECTRIC FURNACES TO REPLACE PRIMARY IRON MAKING BASED ON BLAST FURNACES AND COKE OVENS.

JAPAN INCREASED ITS USE OF CONTINUOUS CASTING FROM 17 PERCENT IN 1972 TO 60 PERCENT IN 1980. CONTRARY TO SOME BELIEFS, THIS JAPANESE ADOPTION HAS TAKEN PLACE, FOR THE MOST PART, NOT BY BUILDING NEW STEEL PLANTS, BUT BY REPLACING EXISTING EQUIPMENT WITH CONTINUOUS CASTING. DURING THAT PERIOD WEST GERMANY INCREASED CONTINUOUS CASTING FROM 14 PERCENT TO 46 PERCENT. WHAT OF THE UNITED STATES STEEL INDUSTRY? IN THAT SAME PERIOD, CONTINUOUS CASTING INCREASED FROM 6 PERCENT TO 20 PERCENT. THE U.S. STEEL INDUSTRY REMAINS SUBSTANTIALLY BEHIND THE WORLD'S STEEL INDUSTRIES IN THE USE OF CONTINUOUS CASTING, A TECHNOLOGY THAT NOT ONLY IMPROVES LABOR PRODUCTIVITY, BUT ALSO REDUCES ENERGY CONSUMPTION MARKEDLY, REDUCES POLLUTION, IMPROVES STEEL QUALITY, AND REDUCES THE AMOUNT OF WASTE STEEL IN PLANT OPERATIONS.

THE USE OF ELECTRIC FURNACE STEELMAKING WAS THE SECOND MOST IMPORTANT CAUSE OF THE DRAMATIC IMPROVEMENT OF JAPAN'S AND WEST GERMANY'S LABOR PRODUCTIVITY IN STEELMAKING. IN JAPAN, ELECTRIC STEELMAKING INCREASED FROM NEARLY 19 PERCENT IN 1972 TO NEARLY 25 PERCENT IN 1980. FOR WEST GERMANY IN THIS PERIOD, THE INCREASE WAS FROM 10 PERCENT TO 15 PERCENT.

A SIMILAR INCREASE IN THE U.S. STEEL INDUSTRY IS LINKED TO WHAT THE OTA REPORT REVEALED AS A REMARKABLE RESTRUCTURING OF THE INDUSTRY DUE TO THE RAPID EMERGENCE OF MINIMILLS. THESE

MINIMILLS ARE BASED ON THE USE OF FERROUS SCRAP IN ELECTRIC FURNACES AND ARE MUCH SMALLER THAN THE BLAST FURNACE BASED INTEGRATED MILLS. DURING THE PAST TWO DECADES THESE MINIMILLS HAVE INCREASED THEIR SHARE OF DOMESTIC PRODUCTION FROM ONLY A FEW PERCENT TO OVER 15 PERCENT TODAY. THE OTA STUDIES PROJECT THAT BY 1990 THESE MINIMILLS, WITH THEIR HIGH PRODUCTIVITY AND PROFITABILITY AND LOW CAPITAL COSTS, MAY ACCOUNT FOR 25 PERCENT OF DOMESTIC PRODUCTION. DURING A PERIOD WHEN FOREIGN STEEL WON THE COMPETITIVE BATTLE WITH UNITED STATES INTEGRATED STEELMAKERS, THE DOMESTIC ELECTRIC FURNACE BASED MINIMILLS WERE SO COMPETITIVE THAT IMPORTS DECREASED DRAMATICALLY IN THOSE PRODUCT LINES IN WHICH THE MINIMILLS SPECIALIZED. MOREOVER, AS THE MINIMILLS HAVE EXPANDED, THEIR PRODUCTS HAVE BECOME MORE COMPLEX AND DIVERSIFIED. THE GROWTH OF THE MINIMILLS, TO A LARGE EXTENT, ACCOUNTS FOR THE SUBSTANTIAL INCREASE IN ELECTRIC FURNACE STEELMAKING IN THE UNITED STATES, FROM 18 PERCENT IN 1972 TO 28 PERCENT IN 1980.

WHAT IS EVEN MORE IMPRESSIVE ABOUT THE IMPROVEMENTS IN PRODUCTIVITY MADE BY JAPAN AND WEST GERMANY IN RECENT YEARS IS THAT THEY TOOK PLACE DURING A TIME WHEN THE OPERATING RATES OF THE STEEL INDUSTRIES DECLINED SUBSTANTIALLY, CAUSED BY REDUCTIONS IN WORLD STEEL DEMAND AND SHARP INCREASES IN STEELMAKING CAPACITY, PARTICULARLY IN THE DEVELOPING WORLD.

IN THE UNITED STATES THE OPERATING RATE HAS ALSO DECLINED, BUT TO A FAR SMALLER EXTENT THAN IN JAPAN AND WEST GERMANY. FOR THE PAST TEN YEARS THE AVERAGE OPERATING RATE IN THE U.S. WAS ABOUT 85 PERCENT, BUT IN JAPAN AND WEST GERMANY IT WAS CLOSER TO 70 PERCENT. AND HIGHER OPERATING RATES USUALLY LEAD TO MORE

EFFICIENT OPERATION. THUS THE IMPORTANCE OF THE CONTRIBUTION OF CONTINUOUS CASTING AND ELECTRIC FURNACE STEELMAKING TO IMPROVING LABOR PRODUCTIVITY FOR JAPAN AND WEST GERMANY IS EVEN MORE IMPRESSIVE BECAUSE IT TOOK PLACE DURING A PERIOD OF SHARPLY DECLINING OPERATING RATES.

BUT WHY HASN'T THE INCREASE IN CONTINUOUS CASTING AND ELECTRIC FURNACE STEELMAKING IN THE UNITED STATES BROUGHT ABOUT ANY SUBSTANTIAL IMPROVEMENT IN OUR PRODUCTIVITY, PARTICULARLY AS OUR OPERATING RATES HAVE BEEN RELATIVELY HIGH?

OTA FINDS THAT THE LACK OF IMPROVEMENT IN LABOR PRODUCTIVITY IN DOMESTIC STEELMAKING RESULTS FROM:

o THE REMAINING LOW LEVEL OF CONTINUOUS CASTING USAGE - ONLY 20 PERCENT - WHICH IS A REFLECTION OF INVESTMENT DECISIONS MADE BY U.S. STEEL INDUSTRY MANAGEMENT

o THE CONTINUED USE OF THOSE INTEGRATED STEELMAKING PLANTS THAT ARE OLD AND INEFFICIENT, ALSO A CONSEQUENCE OF THE INVESTMENT DECISIONS OF U.S. STEEL INDUSTRY MANAGEMENT

o POOR LABOR-MANAGEMENT RELATIONS IN MANY INTEGRATED STEEL PLANTS, WHICH IS VERIFIED BY SUBSTANTIAL DIFFERENCES IN LABOR PRODUCTIVITY AMONG SUCH PLANTS IN THE UNITED STATES.

WHAT OF THE FUTURE? LABOR PRODUCTIVITY COULD IMPROVE SUBSTANTIALLY IN THE UNITED STATES STEEL INDUSTRY DURING THE NEXT TEN YEARS AND WILL TO SOME EXTENT WITH THE EXPECTED REPLACEMENT OF SOME INTEGRATED STEELMAKING CAPACITY WITH NEW MINIMILL CAPACITY. SOME DOMESTIC INTEGRATED STEELMAKERS ARE FINALLY MAKING A COMMITMENT TO GREATER USE OF CONTINUOUS CASTING. BUT THERE ARE ALSO SIGNS, SUCH AS INCREASED DIVERSIFICATION OUT OF STEELMAKING, THAT THE COMMITMENT TO STEELMAKING IN THE FUTURE MAY BE WEAKENING AND THAT INVESTMENTS IN IMPROVED STEELMAKING TECHNOLOGIES, SUCH AS CONTINUOUS CASTING, MAY SUFFER AS A RESULT.

FROM A LONGER TERM PERSPECTIVE IT IS CLEAR THAT MUCH MORE ATTENTION IS NEEDED NOW ON R&D, ADOPTION OF MANY TYPES OF TECHNOLOGICAL ADVANCES AND PLANS FOR SEVERAL MAJOR NEW, INNOVATIVE INTEGRATED STEEL PLANTS DURING THE 1990'S. ALSO NEEDED IS A MAJOR SHIFT IN THE THINKING AND ATTITUDES OF STEEL INDUSTRY MANAGEMENT TOWARDS USING TECHNOLOGY AS A TOOL TO GAIN COMPETITIVE ADVANTAGE. THE IRONY IS THAT THE UNITED STATES HAS THE PHYSICAL AND HUMAN RESOURCES, AS WELL AS A LARGE DOMESTIC MARKET FOR STEEL, TO SUPPORT A HEALTHY, PROFITABLE STEEL INDUSTRY.

FINALLY, YOU MAY NOTE THAT I HAVE NOT DEALT MUCH WITH WAGE RATES. IT IS THE HOURLY WAGE RATE IN COMBINATION WITH THE HOURS NEEDED TO MAKE A TON OF STEEL THAT LEADS TO THE LABOR COSTS IN STEELMAKING. HOURLY LABOR COSTS IN THE UNITED STATES STEEL INDUSTRY HAVE INCREASED DRAMATICALLY AND TO A FAR GREATER EXTENT IN RECENT YEARS THAN IN ALMOST ALL OTHER STEEL INDUSTRIES. CLEARLY LABOR AND MANAGEMENT NEED TO WORK TOGETHER TO SEE THAT LABOR-MANAGEMENT RELATIONS IMPROVE AND, PERHAPS MORE IMPORTANTLY, TO INSURE THAT MORE INVESTMENTS ARE MADE IN INNOVATIVE TECHNOLOGY. IT TAKES CONSIDERABLE TIME TO PUT NEW TECHNOLOGY IN PLACE. THEREFORE, THERE IS A NEED FOR LABOR TO REALIZE THAT IF STEEL INDUSTRY MANAGEMENT COMMITS ITSELF TO SELF-REVITALIZATION, THEN LABOR MAY HAVE TO MODERATE ITS WAGE DEMANDS UNTIL THE INDUSTRY BECOMES MORE EFFICIENT, COMPETITIVE AND PROFITABLE.

WHEN MACROECONOMIC POLICIES DO NOT ADEQUATELY DEAL WITH THE

STEEL INDUSTRY'S PROBLEMS, OTA HAS FOUND THAT THE USE OF A COMPREHENSIVE SECTORAL STEEL POLICY BY THE GOVERNMENT MIGHT BE A USEFUL TOOL TO INSURE ADEQUATE DOMESTIC STEELMAKING CAPACITY FOR BOTH OUR PEACETIME AND EMERGENCY NEEDS, AS WELL AS FOR A PROFITABLE UNITED STATES STEEL INDUSTRY THAT CAN MAINTAIN REASONABLE EMPLOYMENT LEVELS. OUR REPORT ALSO EMPHASIZED THAT TECHNOLOGY ALONE WILL NOT SOLVE THE DOMESTIC STEEL INDUSTRY'S PROBLEMS, BUT NEITHER WILL CHANGES IN TAX POLICIES, ENVIRONMENTAL REGULATIONS OR POLICIES TOWARD STEEL IMPORTS ALONE BE SUFFICIENT.

WHILE IT IS TRUE THAT THERE HAVE BEEN UNFAIRLY TRADED STEEL IMPORTS, MOSTLY FROM EUROPE, WHICH HAVE RECENTLY LED TO AN INCREASE IN IMPORT PENETRATION AND CONTRIBUTED TO LOW DOMESTIC OPERATING RATES, IT WOULD BE WRONG TO CONCLUDE THAT STEMMING SUCH IMPORTS WOULD RESOLVE THE U.S. STEEL INDUSTRY'S PROBLEMS. OTHER TRULY COMPETITIVE STEEL INDUSTRIES COULD, FOR EXAMPLE, SHIP MORE STEEL HERE IF EUROPEAN SOURCES WERE BLOCKED. NEITHER IS THE COST OF ENVIRONMENTAL REGULATIONS IN ITSELF A MAJOR CAUSE OF THE INDUSTRY'S PROBLEMS. THE JAPANESE HAVE HAD SIMILAR ENVIRONMENTAL COSTS AND THE COSTS OF DIVERSIFICATION EFFORTS OF U.S. STEEL COMPANIES HAVE EXCEEDED THE COSTS OF ENVIRONMENTAL REGULATIONS.

THE DOMESTIC STEEL INDUSTRY HAS CONTINUED TO FOCUS ATTENTION ON SOLUTIONS THAT THE GOVERNMENT SHOULD PURSUE. HOWEVER, IT IS THE INDUSTRY'S OWN DECISIONS, PARTICULARLY REGARDING TECHNOLOGY, THAT ARE A CRUCIAL PART OF THE ULTIMATE SOLUTION.

Senator **Quayle**. Thank you very much.

What I am going to try to do is to pursue a line of questioning in an attempt to get a consensus. I am not sure I am going to be able to achieve that. It may be in very broad and vague terms that we might achieve a consensus. But when it gets down to the specifics, just listening to the testimony, it may be difficult.

Mr. Crandall, you said at the outset that the auto and the steel productivity growth has increased.

Mr. **Crandall**. Auto productivity growth has increased. Steel productivity growth has decreased, but no more rapidly than general manufacturing, and general manufacturing has declined less than the rest of the economy.

Senator **Quayle**. How about steel productivity in a comparison with Japan and West Germany? Has that decreased or increased?

Mr. **Crandall**. Well, there again one has to be careful in specifying over what period of time.

Our relative rate of growth of steel productivity in the United States relative to the Japanese remains low. Whether it has changed in relative terms, whether that gap has changed very much, I do not know. I do not have the numbers right before me.

I think actually Don Barnett would be a better person to answer that question than I am.

Senator **Quayle**. Mr. Barnett.

Mr. **Barnett**. I would agree with him. We are not doing as well as the Japanese.

I suppose that when we compare, recognizing that both have done worse after the mid-1970's, if you looked at actual operating rates, we would have to say that we did comparatively better relative to the Japanese. Let us say we were doing 1½ to their 3½ versus 2 to their 10.

But in one sense that is not a fair comparison because we are talking about an actual volume. If we took standard volume, I think they would be a little better.

But, all in all, I do not think there has been much change in the relative performance of the two industries.

Senator **Quayle**. Let me see if I can extract this from each one of you.

Mr. Crandall, you sort of paint a gloomy picture in the future for the steel industry. You talk about maybe closing the inefficient plants and you refer to the fact that there has been no new plant since 1962. You do not really see one coming.

Of course, Mr. Barnett, you talk about that they are just waiting there for the modernization; that it is just about ready to go.

And Mr. Hirschhorn says: Well, if they are really going to do it, it is going to have to be an industry commitment. And he lists all sorts of things: Technology, institutional change, improvement of labor-management relations.

Would it be a fair agreement that this word "productivity" and enhancing productivity would be beneficial to the steel industry?

Mr. **Barnett**. Yes.

Mr. **Hirschhorn**. Yes.

Mr. **Crandall**. Yes.

Senator **Quayle**. There is really no dispute about that.

Now, I guess my question goes into how are we going to enhance that productivity?

Mr. Crandall, you talked about the trade policies are really serving as somewhat of a disincentive to productivity.

I wonder if we could narrow into this issue of enhancing productivity. I mean making it better; increasing on a comparison basis. Is there a way that we can zero in on that?

Mr. **CRANDALL**. There are two things here.

I said that trade protection is harming the prospects for our industry because it is reducing the potential market for steel in the United States.

Even Mr. Barnett, from the industry trade association, admits we are not going to compete outside our own borders in carbon steel in the future.

Second, the technological factors and market factors that Mr. Hirschhorn identifies in terms of the advantage of these minimills using electric furnace production are focused principally on firms that are different from the major integrated companies. That is, these new technologies and this new form of operations are going to be dominated by a different set of firms.

There is a very simple reason for that: The wage rates. They can pay wage rates about half what the wage rates are in the integrated companies. The integrated companies are not going to be able to drive their $21.60 per hour total compensation cost down measurably in the future. And, as a result, it is going to look less attractive to build dynamic facilities at those wage rates than to have Nvcor or Georgetown Steel build them at much lower wage rates.

Senator **QUAYLE**. So, by going to the mini industries, you are saying that one of the key factors is the wage disparity where they can get a cheaper wage rate.

Mr. **CRANDALL**. Certainly.

The facilities owned by the integrated steel companies cannot easily accommodate some of the changes in technology which you heard about here today. That is, the large steel companies have plants that are poorly designed to accept them. And, second, they have very high wages. This makes it uneconomic for them to spend as much money as they would like to have you believe they want to spend in their plants.

Mr. **HIRSCHHORN**. I would like to comment on that.

Senator **QUAYLE**. Mr. Hirschhorn.

Mr. **HIRSCHHORN**. I would like to comment on wage rates in minimills versus large integrated companies.

While it might be true that the hourly rates show a difference and a lower hourly rate for minimills, I would emphasize that the total compensation for a worker in a minimill is about the same as a worker in an integrated steel mill. The difference is in the management approach. The management of minimills use various incentive programs, bonus programs, to motivate the workers to improve their labor productivity and get their compensation up in various other ways than a particular hourly rate.

So, again, my stress is on management. And I want to emphasize that minimills have succeeded in conditions of Government policy, which, in fact, not only did them no good, but really distorted the marketplace in favor of integrated companies.

Senator **Quayle**. Could you break this minimill aspect down and give us some examples? Who are we talking about out there; the minimills?

And you talked about incentives rather than the actual wage rate. Can you give us some specifics on that?

Mr. **Barnett**. Normally a minimill is supposed to be or had been in the past defined as being a plant of less than 500,000 tons and let us say an integrated operation of above 3 million tons.

But that has changed. I think a lot of them, you talk about 1 million tons perhaps and less as being a minimill.

I do not think they are particularly fond of the term "minimill." They are more market mills. They deal in a slightly different—well, I would say more than slightly different type of product grouping than do the integrated companies. The integrated companies are increasingly stressing flat rolled and that end of product mix and structurals and so on.

They do overlap, of course. But I am saying that it is perhaps a difference in product mix rather than a difference in size.

Senator **Quayle**. Who represents the employees in the minimills? The U.S. steelworkers?

Mr. **Crandall**. Some of them are non-unionized.

Senator **Quayle**. Some of them are non-union.

Mr. **Hirschhorn**. Some are, but for the most part U.S. minimills are non-unionized; yes.

Senator **Quayle**. What percentage of domestic steel production are we talking about being manufactured now by the minimills?

Mr. **Hirschhorn**. It is roughly about 15 percent right now.

Senator **Quayle**. Is it growing?

Mr. **Hirschhorn**. Very rapidly.

Mr. **Barnett**. I must point out this has been a bad year for them.

Mr. **Hirschhorn**. Absolutely.

They have been adding, on the average for 10 years, 1 million tons of production capacity a year and that rate is continuing. There is now about 5 million tons of new capacity being built, or actually in construction in some way, in U.S. minimills for the next few years.

Senator **Quayle**. We have heard a lot of discussion in the auto industry of the labor differential between Japan and the United States and it is about $8, I believe, around there. And it translates into the best estimate of about $1,015 per automobile.

Do we have a similar comparative figure that we can agree on on the labor differential for domestic labor here versus Japan and West Germany?

Mr. **Crandall**. Mr. Barnett gave you the numbers in terms of the costs per ton of steel, at least the relative rankings. That is, our labor costs for a ton of steel are about twice as high as those in Japan. And part of that comes from differences in productivity.

The wage rate differential is about the same; around $8 an hour; maybe a little bit more; maybe $9.

A way to look at this, Senator, is that in our automobile and steel industries, the differential paid to those workers over the average manufacturing wage is much higher than it is in any other developed country. In the United States we pay 75 percent more per man-hour for labor and steel than we pay the average manufacturing worker. In Europe it ranges between 15 and 25 percent. In the highly successful Japanese industry—and this is likely to go down in the future—it is about 50 percent.

So, we have a much higher differential.

Senator **Quayle**. But it is a reasonably accurate statement to say that the cost differential in labor costs is about $8 or $9 and about the same in the auto industry?

Mr. **Crandall**. Yes.

Most of the cost differences between ourselves and the Japanese can be accounted for by labor cost differences.

Senator **Quayle**. I just visited Inland Steel and I asked that same question and I got a little bit different answer. They were not quite as willing to say that there was this disparity because of the way that they compute the hourly wage and also the computation into the number of tons. They were not willing to concede that there was this disparity.

But I detect today that there is really a disparity.

Mr. **Barnett**. There is no question that there is a disparity. I guess it is a question of the degree, I suppose.

Senator **Quayle**. We are talking about a ballpark figure of $9 an hour. And everybody has indicated right here that—you used the term 75 percent differential—that they are considerably higher paid. And also I detect that there is a decision being made to go more toward the minimills type of situation basically on wage.

Mr. **Barnett**. Also on scrap. They use scrap rather than iron ore as their basic input. And of course as long as scrap prices remain low, and they have been fairly low recently, that is an incentive. If scrap prices rise to any significant degree—I am not saying they are, but if they rise to any significant degree, that will be a disincentive for them.

Mr. **Hirschhorn**. On the other hand, I think it is important to note that the actual productivity, the man-hours per ton to make steel, in the minimill is something about 25 or 50 percent of the man-hours per ton to make steel in an integrated mill. And that has to do with the choice of processing technology, the whole process stream.

Mr. **Crandall**. And the product.

Mr. **Hirschhorn**. And the product.

Senator **Quayle**. That gets back to your assessment on the technology and the institution.

Mr. **Hirschhorn**. You cannot separate these factors.

Mr. **Crandall**. There is one thing you should understand though. And that is that the basic flat rolled products, the sheet steels, are not yet produced by these so-called minimills because it takes 3 million tons or more to run the first process the hot strip mill, for sheet steels.

So, what we are talking about is a nonintegrated minimill sector producing the nonflat products, those that do not go into appliances or automobiles or tin cans, but rather the products which go principally to the construction industry.

Senator **Quayle**. I know the difficulty in just separating one factor of the productivity issue out. But it seems to me that a key factor is obviously the labor-management relations and also the amount of labor costs that go into the domestic steel production. I do not think there is any or at least I do not detect any dispute on that. There obviously are other things.

If that is the case, how would we go about getting concessions or getting changes so that, we can be more competitive?

Mr. **Crandall**. Here is where the situation again is not an optimistic one compared to the automobile industry. And the reason is as follows:

In the case of steel you have the endowment of existing assets. Except for new construction of minimills, you are not going to see new plants. Unless you find the market declining so rapidly that when combined with productivity increases, it generates reductions in employment more rapid than just natural attrition rates—you are not going to get much willingness on the part of labor to grant concessions. As a matter of fact, the Midwestern plants of big steel companies have been the most aggressive in pressing for ever higher wage rates. They almost elected their own man, who is more agressive on this score than the current leadership of the United Steelworkers, in 1977.

In the automobile industry you have retooling which goes on periodically every 3 or 4 years, and this constitutes a very large part of the capital stock of that industry. The threat to move that tooling out of the Great Lakes area to the Sun Belt or abroad puts a lot of downward pressure on wages. You do not have that threat in the steel industry and as a result I would not expect to see wages moderate as much in steel as they are in auto.

Senator **Quayle**. Do you agree with that, Mr. Barnett?

Mr. **Barnett**. I cannot comment really. That is not my expertise. But we do have experts who would be happy to comment on that at a later date, if you would like.

Senator **Quayle**. I would like to see if you could submit something on that particular issue.

Just from first glance at the situation, and being from Indiana and having both auto and steel, it seems to me that auto is establishing a precedent that, in fact, could be followed.

Now then, Mr. Crandall talks about the pressures are not the same on the steel industry as it is on the auto industry. But those pressures could build, particularly if nothing is done on the allegations of the dumping subsidization from West Europe. I do not know what is going to happen there. I know that the Western European people feel that a $17 billion surplus of us to them, we are not about to get into any kind of quotas or serious countervailing duties. I think they may be misreading the public's attitude toward protectionism a little bit, but that is certainly their situation or their assessment of the situation.

Mr. **Hirschhorn**. Senator, may I make one comment about that?

Senator **Quayle**. Yes.

Mr. **Hirschhorn**. I think there is a major difference between the automobile industry and the steel industry in that regard. There are a number of signs to indicate that in the steel industry there is a declining commitment to stay in steelmaking. In the automobile industry, in fact, you can see the opposite. You can see divesting of nonautomotive kinds of operations. There is a stronger commitment to stay in the automotive business.

I think from a worker point of view, and other points of view, there is an abundant amount of evidence over a period of 10 years or more to indicate that the people who run and own steel companies are getting out of the steelmaking business. Therefore, if concessions are to be made on the part of labor, they really have to be tied to some long-term commitments on the part of the steel companies themselves to stay in the business. Otherwise, the companies, the plants, will simply be milked dry and there is no future for anyone.

Senator **Quayle**. In other words, the issue of job security, I presume, is what you are referring to.

Mr. **Hirschhorn**. I think it is a two-way street. If one looks for concessions from labor, then there has to be a stronger commitment from management simply to stay in the business and to invest to give the tools, the proper facilities, to the workers to make productivity even a meaningful issue.

Mr. **Crandall**. But to make sure that that is a wise use of our scarce savings, perhaps you should talk again with Inland Steel and ask them how they reflect upon their recent investments. They have been the most aggressive in recent years in investing to modernize their plant and they have one of the most modern plants in the United States, the Indiana Harbor Works, which I believe is now the largest in raw steel capacity in the United States.

I think they would tell you that they are not sure that the investments they made there were wise, despite the fact that they are probably in the best location for producing steel in the United States.

Another person perhaps you should talk to would be someone at the Steel Company of Canada, which also has made major investments on the other sides of the Lakes, on the other side of Lake Erie. I think that they are now having second thoughts about whether building a new steel plant over there made sense.

In short, I am not sure that a commitment to investing in a declining industry is a good thing. I am not sure that a phasing out of investment does not make sense.

Mr. **Barnett**. I would put it a little differently, but I would tend to agree to some extent. I would say it is not a good idea to tie your union contract down saying we will stay in steel, irrespective of profitability of the operation you are in. Obviously, companies have to go where the rate of return is.

We believe that it can be in steel, but it would be, I think, a mistake to say we will stay in the business even if it is not profitable.

Senator **Quayle**. What does United States Steel's decision to purchase Marathon tell us? Do you find this as an indication that perhaps the rate of return is not there and, therefore, the commitment that some of the workers are looking for before they can make any kind of concession really is not there; that they are going to get into other things and maybe not be as concerned about domestic steel production?

Mr. **Crandall**. There are a few things that one needs to know about the Marathon acquisition.

In the first place, it is almost as large as the value of all the outstanding common stock of all the steel companies of the United States. It was a huge investment. It could not have been undertaken by United States Steel except with the consent of those people at the bottom of Manhattan Island. They would not have consented to give them that line of credit to put it into steel because it simply does not look productive to most people making an investment.

Now, in retrospect, even to them the Marathon investment does not look very productive because the value of United States Steel stock is down about 25 percent since they made that acquisition. The market is now reflecting badly on their own choice.

But I do not think one should look at that as a declining commitment to steel. After all, management serves the interests of stockholders and are responsive to capital market conditions. They simply could not get that money to put it into steel.

Senator **Quayle**. But that is what you are saying as far as the future holds for steel; that they are making these decisions because the rate of return is simply not there. You questioned whether Inland made a wise investment.

Mr. **Crandall**. I am saying I think they are questioning it.

Senator **Quayle**. You were talking about a Canadian company that is making an investment in a modernization and very much of a forecast of nongrowth in the steel industry.

That is, basically, what you are telling me.

Mr. **Crandall**. Yes; I think we are going to see a continuing decline in the integrated steel industry. I do not think we are going to see a collapse. But we are just going to see some plants close and our total steelmaking capacity decline slowly.

I do not think that is a disaster for the American economy.

Senator **Quayle**. Do you agree with that, Mr. Barnett?

Mr. **Barnett**. I will agree to this extent: It is happening. I think the industry's perspective is a little more long term. They believe that the market is there, let us say, in the United States and they can effectively serve that market. The market may not grow very rapidly. It will probably grow slowly, at least until the current automobile situation is resolved as to what is going to happen. That will probably be through 1985. After that I would say they are talking about moderate growth in the market.

The question is who will serve the market; the American industry or its competitors? The American industry believes it can compete effectively. It may not serve the whole market, but it can serve the large majority of that market—let us say 80 percent or whatever—and on a full cost competitive basis.

But it cannot do that unless the investment commitments are made and so on and the modernization takes place, there is restraint on costs, and the Government policies are appropriate.

Senator **Quayle**. If we are not going to increase our supply of steel, I would presume that that slack would be picked up by mainly Japan and West Germany.

Mr. **Hirschhorn**. And Third World countries?

Senator **Quayle**. And Third World countries.

Because there is not going to be any slow down in the future for demand for steel.

Mr. **Hirschhorn**. I would say that what we are seeing is happening elsewhere too, perhaps not in the Third World area, but it is happening in Europe, it is happening in Japan. The slow down in automobiles and so on is not just here. The energy crisis effects, which are still running on, are pervasive. They are everywhere.

The Third World had a lot of catching up to do because it did not have much capacity. It had a lot of infrastructure to put in place; roads, bridges, buildings, and so on. So, it is adding steel, sometimes for political reasons, but for those purposes.

But the maturing economies are seeing a slowing in the growth of demand for steel, which began—I guess it began earlier, but the energy crisis brought it to the floor.

Mr. **Crandall**. Non-Communist world consumption of steel is no higher today and probably slightly lower than it was in 1974. A large part of this is due to slow economic growth in the OECD countries.

But, in addition, given higher energy costs, there is substitution against steel. A drive down the street will show you. I think that is likely to continue for some time unless oil prices are going the other way for quite a while.

Senator **Quayle**. So, you do not see a great world increase in demand for steel?

Mr. **Crandall**. No.

Senator **Quayle**. What is the capacity of the European steel-mills now? About 75 or so?

Mr. **Crandall**. When you have a large percentage of your furnaces shut, it is a difficult question to answer. It is always difficult to answer the question of what is capacity. The numbers generally hover in the range of 160 or 170 million raw tons of capacity. But there is considerable skepticism about that because there is considerable feeling that many of those furnaces will never be reopened.

Mr. **Barnett**. They reacted very promptly—and unfortunately, from their perspective—to the boom in steel demand in the mid-1970's, 1973–74, which, of course, the energy crises came precisely the same time. They went ahead with very ambitious plans.

I think British Steel Corp. was going to go from 20 million tons to 32 and now is going to go to 14 or something. It is altogether a different direction.

So, they overbuilt capacity.

American companies did not respond as rapidly because they knew from past experience that this could be short lived, and so it was.

The Japanese got caught, but I do not think for the same reasons as the Europeans. They had been steadily building capacity in all their markets, whether in Europe or South America or whatever. All of them got hit.

Senator **Quayle**. What is the comparison of plant capacity here or percentage of utilization on a comparative basis?

Mr. **Crandall**. Around 70 percent.

Mr. **Barnett**. Seventy percent.

Mr. **Crandall**. Seventy percent.

Mr. **Barnett**. Sixty-five percent in Japan and maybe 55 or 50 percent in Europe.

Mr. **Crandall**. It depends again on what capacity. That is probably about right.

Mr. **Barnett**. This is not exactly normal. Normally we are somewhere in the high seventies low eighties here; Japan is in the low seventies and Europe has been in the sixties I guess.

Senator **Quayle**. Mr. Crandall said that he did not foresee another major integrated plant ever built in this country. I believe that is what he said.

Mr. **Crandall**. In the foreseeable future.

Senator **Quayle**. In the foreseeable future.

Mr. **Crandall**. I do not know that I can see 10 years.

Senator **Quayle**. Do you agree with that?

Mr. **Barnett**. I tend to agree.

First of all, the lead times involved are very long. You would have to start it now to have it done in this decade essentially if you are talking about a nuclear plant because it is very difficult to get the permits and so on and so forth.

So, I do not think we are likely to see one in this decade.

Mr. **Crandall**. Another jarring fact is that the cost of a single new efficient-scale plant in the United States exceeds the value of all of the outstanding stock of all the integrated steel companies. And as a result, given that it cannot pay for itself, that it would probably be worth about two-thirds or 70 percent of what you would have to pay for it, it would wipe out the equity of all but one company. That is United States Steel. It would wipe out the equity of Bethlehem or Inland just to announce that it is building a new plant.

So, it cannot be built under those conditions.

Senator **Quayle**. Mr. Hirschhorn.

Mr. **Hirschhorn**. I would like to comment on that.

I think there is a strong possibility of a major new plant being built. It probably would not be built until the early 1990's. But when it is built, I think there will be two differences.

No. 1: It may very likely be built by a foreign company. Right now there are long-range plans being made by foreign investors to invest more money in the U.S. steel industry. In fact, in the last several years there has been a substantial amount of foreign money going into the U.S. steel industry.

And I think the second aspect of a major new integrated plant is it will be different technologically because in a number of locations around the world they have poured incredible amounts of R. & D. money into developing new technology for integrated steelmaking in order to reduce the capital and operating costs. They have made very, very heavy investments overseas in new steelmaking technology. And I think eventually we will see that manifest itself here.

Mr. **Barnett**. Well, the perspective of the American companies, I believe, and the reason why there is no great urgency, I think, in building new plants is because the technical changes which are available have not been fully implemented yet and lead to great yield improvements and so on and make it possible for the existing plants to increase their shipments without apparently increasing capacity. Because raw steel production can go on, but finished yield shipments can go up dramatically and there are some ways to improve yields and so on.

So, since the market is not seen as growing very rapidly they believe they can achieve most of the benefits or a large majority of the benefits that you could get in an integrated plant you would want to build now without building and using the existing sites and so on and by modernization improvement.

Senator QUAYLE. Mr. Hirschhorn, you talk about potential foreign investment in developing a new plant.

Are you talking about Japan, West Germany, in particular?

Mr. HIRSCHHORN. Yes.

Senator QUAYLE. More particularly Japan, since we have the deficit over there on balance of trade of $20 billion.

Mr. HIRSCHHORN. I am aware of plans by the Japanese to invest money here in steelmaking. And we already have one plant, a minimill in the United States, that is Japanese. We have a new plant that has been constructed in New Orleans with European money; Austrian money. There is German money. The Korf operations are essentially West German and, in part, Arab.

So, there are a number of examples of foreign investments.

Mr. BARNETT. But some of it is Canadian.

Mr. HIRSCHHORN. And Canadian, as Don points out. There are three or four minimills in the United States which are Canadian owned.

So, I think it is interesting that foreign investors do see opportunities here.

I also want to point out that at the same time the large integrated companies—and for very legitimate reasons—do not see the investment opportunities here, again the minimill owners do see the investment opportunities and they are making the commitments.

Senator QUAYLE. I have one final question that I would like to ask each of you. It is about the current trade policies, trade situation, with steel.

There have been a number of allegations, court suits, dumping subsidization. From your perspective, first of all, are they valid?

Second the influx of huge amounts of imports, I think it is up to 30 percent. My latest figures are close to 30 percent and come from outside the United States.

First of all, do you think that subsidization dumping argument is valid?

Secondly, does this 30 percent influx of foreign imports into this country serve to hurt, on a competitive basis, our steel industry?

Who wants to start first?

Mr. Crandall.

Mr. CRANDALL. When you start talking about factual determinations in these suits, there is a great uncertainty as to what the law is as to subsidization. I would be surprised if many of the dumping charges hold simply because of the change in currency rates. That is, the decline in the value of the European currency has made our market look very attractive relative to their home market prices.

The subsidy issue turns on whether, in fact, the subsidies paid, which have been largely the bailing out of the owners of capital and also providing some direct subsidies of other sorts to labor—also some penalties in terms of requiring the purchase of local cull—whether those subsidies actually drive down the price of steel in export markets. They are not specifically export subsidies. They are just simply a creeping nationalization of that industry.

I doubt that we are to the point where we want to define socialism as subsidy. That is, every time we encounter a socialist country exporting to our country, would we assume all their capital costs have to be doubled? But, on the other hand, there can be no doubt that there have been subsidies paid in Europe and these undoubtedly have kept some facilities alive longer than they should have been kept alive and, therefore, contributed to output and a lower price.

I think the Commerce Department has a lot of latitude in making decisions in this area and they ought to have a lot of fun doing it.

Senator QUAYLE. Do you believe that this is in any way harmful to the competitiveness of the productivity of the steel industry; 30 percent?

Mr. CRANDALL. Well, there is no doubt that the current world steel market is very harmful to the domestic steel industry. What we are observing is very weak prices because of this tremendous overhang of excess capacity. One would expect prices to be weak.

We cannot pretend that we are not part of a world market and try to keep our prices high without paying a long term penalty for that in terms of our steel fabricating industries.

But there is no doubt that imports at these prices are harmful to our industry in the sense that they are not making as much money as they would in better times.

Senator QUAYLE. Mr. Barnett.

Mr. BARNETT. I would answer affirmative to both of your questions.

Yes. There is a sound basis for the complaints because there are subsidies and, of course, there has been nationalization. Of course, it gets very difficult to question whether it is a subsidy of a steel corporation when it is government owned and they just keep pumping in the money. But it is clear they can do things that a private company could not. I suppose that comes down to the real issue of the complaint. They can survive and make investments under circumstances in which a private company would fold. And, of course, they keep excess capacity and sell it abroad and they overbuild capacity and somehow we are bearing the brunt of that.

We believe it is very disruptive to the American market on a short term basis, of course, and it may very well be an increased incentive to ship to the American market because of exchange rates. I do not disagree with that. But it is disruptive because it comes precisely at a time when our market is at a low point.

And, of course, their purpose in doing it is to keep their operating rate up, which becomes, I suppose, a type of economic warfare pushed to extreme. We are going to keep our employment up and, therefore, you are going to keep your employment down.

I am not saying that is what it is, but I am saying in the extreme that is what it would be. It has the effect of exporting employment.

Senator QUAYLE. Mr. Hirschhorn.

Mr. HIRSCHHORN. I think it would be a grave misreading of the situation to think that if this current import problem was resolved we would have done anything meaningful to deal with the actual chronic problems of the U.S. steel industry.

It is easy for the industry, as well as for individuals, to try to externalize the problems, the causes of the problems, try to seek solutions outside of themselves.

Sure. Imports are hurting the industry right now. But I think it is pretty clear that no matter what we do about the imports from Europe, there are much more difficult fundamental problems facing the industry. So, we should not concentrate on imports.

Senator QUAYLE. Mr. Barnett, Mr. Hirschhorn, Mr. Crandall, I thank you very much. We will stay in contact with you. We appreciate you coming down here and giving your fine testimony.

Thank you.

Our next panel is Mr. Dallob, Mr. Merchant, Mr. Schuh, and Mr. Davis.

Mr. Dallob.

STATEMENT OF DAVID L. DALLOB, STAFF VICE PRESIDENT FOR OPERATIONS DEVELOPMENT, SPERRY CORP.; M. EUGENE MERCHANT, PRINCIPAL SCIENTIST, CINCINNATI MILACRON; G. EDWARD SCHUH, PROFESSOR AND HEAD, DEPARTMENT OF AGRICULTURAL & APPLIED ECONOMICS, UNIVERSITY OF MINNESOTA; AND E. G. DAVIS, VICE PRESIDENT, CORPORATE AFFAIRS, ELI LILLY & CO., ACCOMPANIED BY JOHN VIRTS, SENIOR CORPORATE ECONOMIST, ELI LILLY & CO.

Mr. DALLOB. Mr. Chairman and members of the Subcommittee on Employment and Productivity: My name is Dave Dallob and I am staff vice president of Operations Development of Sperry Corp.

I am pleased to have this opportunity to provide testimony to the subcommittee.

Sperry Corp. is world leader in important and diverse high technology growth industries. Our major product lines are computer systems and equipment, specialized farm machinery, fluid power equipment, and aircraft and marine instrumentation.

Headquartered in New York City, Sperry employs 89,000 people worldwide, 62,000 of whom are in the United States. We operate approximately 60 manufacturing plants and have facilities in more than 40 States.

For the last 5 years Sperry productivity, as measured by revenue per employee, has grown at a compound rate of approximately 12 percent.

It is a matter of both history and economics that improvements in productivity come from three sources. These are technology and innovation; increasing capital investment per worker; and improving levels of individual skill, education, and experience.

A corollary of this is that improving productivity creates jobs. The rate of job creation is directly related, as a result, to the rates of increase in the three sectors contributing to productivity gains.

In the years since the Second World War, the most dramatic gains in productivity and job creation have been made in what are generally referred to as "high-technology" industries. Specifically, statistics for the 25-year period between 1950 and 1974 indicate that high technology industries experience productivity rates that would double and employment percentage increases that were nine times greater as compared to industries characterized as low technology.

These high tech industries have a common characteristic. Each makes a much greater investment in all three sectors mentioned previously than is typical of industry generally.

This paper will discuss aspects of the three sectors that create productivity improvements with some special reference to the Sperry Corp.

With regard to technological change, we saw that from the end of World War II until 1965 the GNP tripled, but expenditures for R. & D. multiplied 15 times. During the same timeframe, as you know, this country had the greatest economic growth of any nation in history, which was accompanied by political and economic stability, positive trade balances, rising productivity and many other effects.

The result, naturally enough, was that the United States became a symbol for other developed nations of what organized research and development could do. Most of them set R. & D. targets that would close the gap between them and us in terms of the amount of GNP spent on innovation.

But then, about 1969, the United States R. & D. enthusiasm began to wane. Since then, by most statistical measures, United States R. & D. commitment has been eroding.

The National Science Foundation has reported that in the decade from 1967 through 1977, the annual rate of change in R. & D. expenditures, measured in 1972 constant dollars, has actually been minus 0.2 percent.

In terms of GNP, R. & D. expenditures are now about 2.6 percent, compared with the peak penetration of 3 percent in the mid-sixties. In any case, the important point is that research and development is responsible for approximately 60 percent of all real productivity gains. If we do not invest sufficiently in R. & D. today, we will surely pay a productivity cost in the future.

Sperry, as are other high technology companies, is extremely conscious of that fact. Our R. & D. expenditures per employee have increased 272 percent during the last decade. As a consequence, in just the last 5 years our U.S. blue-collar employment has increased nearly 14 percent and our white-collar employment is up 79 percent.

One of the characteristics of high-technology industries is that they invest not only in research and development, but also in the plant and equipment to take R. & D. to the marketplace in the form of products or services. In most cases, this plant and equipment investment must also represent the very newest in technology.

For example, in Eagan, Minn., Sperry Corp. has under construction a new plant which will manufacture some of the world's most advanced electronic microprocessors. But, in order to manufacture these extremely small complex circuits, we must invest in the newest, most advanced kind of equipment available. In this case, equipment to do electron beam lithography.

One consequence of this need for very high technology in production is that Sperry's annual expenditure for plant and equipment is five times higher than it was a decade ago, as contrasted with

American manufacturing industries generally where the investment in new plant and equipment is only about three times greater than in 1972.

We can see the relative impact of innovation and investment by comparing the annual growth rates measuring high-technology against low-technology industry between 1950 and 1974. The growth rate in sales of high-technology industries was nearly triple that of low-technology industries and high-tech industries shared their productivity and sales gains with the general economy by holding price increases to one-sixth those of the low-tech industries.

Further data and studies indicate that this trend continues.

The third and most important part of the productivity triad is the individual. Obviously the functioning of the other two is wholly dependent on the third.

High-tech industries are much more dependent upon improvement in personal skills, education and experience than are other kinds of business. This is because both the nature of their product and their performance center not only on information process—the case with many industries—but also on the expansion and transfer of knowledge at a consistent and rapid rate, via research, development, and communication.

In the future, the profile of the American work force, especially that in manufacturing, is going to look more and more like high-technology industries' profile today.

If we extrapolate the basic demographic trends of the past 20 years, we can get this perspective profile of the U.S. work force in the year 2000:

The white-collar employees will increase as a percentage of the work force from 41 percent to 58 percent.

Blue-collar employees will decrease as a percentage of the work force 34 percent to 29 percent.

And service and agricultural workers will make up the balance.

Now, those are simple projections. Some futurists predict that the white collar share of the work force will be closer to 70 percent with the difference coming from the blue collar and, to a lesser degree, from the service sectors.

Peter Drucker predicts that eventually blue collar employment in manufacturing will account for no more than 3 to 6 percent. This forecast of blue collar participation in the future work force may appear extreme. However, there is a historical precedent in the United States; namely, the dramatic impact of technology and mechanization in agriculture.

The invention of such farm machines as the harvester, the tractor, and the one-man haybaler, which was invented by Sperry's New Holland Division, freed labor from the land. A little over a century ago agriculture accounted for more than one-half of the U.S. work force. By 1900, it was down to 37 percent. And, that share has continued to drop until today when it is less than 3 percent of the work force. Yet, the agricultural sector produces incredibly more today than it did previously.

The point is that dramatic changes in the work force brought about by technology, innovation, and investment have long-range and far-reaching beneficial effects.

But this does not mean that the implications of dislocation can be ignored. Raw data projections of labor force changes fail to indicate the significant character of these changes which will materially affect not only relationships, but the way business is carried out.

Increasingly, production will come from a white collar work force of scientists, engineers, and technicians interfacing directly with the tools of output. As you know, that is accomplished in some sectors of production today and the trend is clearly for more. In that situation, the skilled blue collar craftsman turns into a white collar technician or supervisor.

The transition will be from jobs that are dangerous, boring, and which offer little in the way of job satisfaction. New tasks for the employee may consist of programing robots, maintaining automated systems and/or making management level decisions through the use of distributed user friendly data processing.

So, while we have a continuing shift of people from blue to white collar, we also will have many shifts within the makeup of the white collar work force itself.

For example, utilization of office information systems is going to dramatically enhance many office positions.

The important thing to remember in this process is that most people feel threatened by change. As a consequence, they feel particularly threatened by the possibility that some piece of hardware is going to come in and take their living away from them. This is an old problem.

You have all heard the story of the Luddites. It has been repeated in many different ways and places since the 19th century. Yet, if history teaches us anything, it is that technological change creates jobs, opportunity and wealth. Certainly, the electronic computer industry is an example of that. From a work force of perhaps two dozen people in 1946, the industry today employes hundreds of thousands of people worldwide. It is the fifth largest manufacturing industry in the United States. In 1981, the U.S. data processing and business equipment industry had a net trade surplus of nearly $7 billion, up 14 percent over 1980. In myriad ways, this industry is improving both the explicit standard of living and the implicit quality of life for all Americans.

In the foregoing brief discussion, it has been the objective to show that:

Productivity and technological changes derive directly from a heavy commitment to research and development;

That these positive changes are put in place via continuing investment in new plant and equipment;

And, that they are made effective by a work force whose skills, education, and experience continue to progress.

It is the view of the Sperry Corp.'s that it is clearly in the best interest of the United States to advance all three parts of this productivity triad by creating national policies and/or law which would:

Encourage and support a manpower policy which guarantees that the work force will be trained and educated in the application and use of current and emerging technology;

Provide still faster recovery of capital invested in new plant and equipment, especially those investments implementing technological changes;

And third, encourage greater private sector and Government expenditures on research and development. Specifically, we believe it should be a national goal to have an aggregate national R. & D. expenditure equal to 3 percent of the gross national product, the level reached a generation ago and since eroded.

Mr. Chairman, thank you for the opportunity to express Sperry Corp. views on productivity. I hope that this presentation, as well as the more detailed paper submitted, are of assistance in your deliberations.

I am prepared to answer any of your questions at the appropriate time.

[The prepared statement of Mr. Dallob follows:]

STATEMENT OF DAVID L. DALLOB, STAFF VICE PRESIDENT, OPERATIONS DEVELOPMENT, SPERRY CORP.

Introduction

It is a matter of both history and economics that improvements in productivity come from three sources. These are:

- Technology and innovation;
- Increasing capital investment per worker;
- Improving levels of individual skill, education and experience.

A corollary of this is that improving productivity creates jobs. The rate of job creation is directly related, as a result, to the rates of increase in the three sectors contributing to productivity gains.

In the years since the Second World War, the most dramatic gains in productivity and job creation have been made in what are generally referred to as "high-technology" industries. These industries have a common characteristic -- each makes a much greater investment in all three sectors listed above than is typical of industry generally.

This paper will discuss aspects of the three sectors that create productivity improvements with some special reference to the Sperry Corporation.

Technological Change

Since the Second World War, entirely new industries -- employing hundreds of thousands of people -- have grown-up as a result of advanced technological development in the U.S.

Among them: the chemical, pharmaceutical, nuclear, computer, electronics, optics and polymers industries. Increasingly, these dominate the manufacturing sector of society. They provide the lead -- in terms of product cycles -- for all of the advanced industrial societies.

These science-based industries, unlike industries which arose in the 19th century, are primarily dependent on theoretical work prior to production. They continually turn back to R&D to develop new or improved approaches to all kinds of situations. Many of them are situations which were created by earlier innovation.

Sperry Corporation is typical of the science-based industries.

Its founder, Elmer Sperry, invented the marine gyrocompass and other ship navigation, guidance and control systems early in this century. His son, Lawrence Sperry, invented the aircraft automatic pilot and other aircraft guidance and control devices. These inventions and their modern counterparts have contributed enormously to the marine, aviation and space programs of this country.

During World War II, at the University of Pennsylvania, John Mauchly and J. Presper Eckert developed the first electronic computer, ENIAC, and thus began a technological revolution that continues to change all of our lives.

That first electronic computer and its current descendents provide a classic case study of the dramatic impact that technological change can have.

ENIAC was comprised of vacuum tubes and wiring. It weighed thirty tons and filled a room thirty by fifty feet. When it was operated, the inventors had to notify the Philadelphia Electric Company because it drew so much power.

Today, all of the computing power of ENIAC -- and more -- fills a silicon chip the size of a fingernail.

Historically, but especially since World War II, the United States and science-based companies like Sperry, have been in the forefront of worldwide technological change.

This didn't come about because we have some franchise on brains. Rather, it came about because we -- meaning high-technology industry in particular -- innovated in the organization and management of R&D. In fact, one scientist/writer has described the organization of R&D as "the pre-eminent discovery of the twentieth century."

The result is that organized R&D has been, perhaps, the most dynamic force in the American economy.

For example:

- In its current fiscal year, ending March 31, Sperry Corporation will spend about $396 million of its own funds on research and development. In addition, it has budgeted the expenditure of about $236 million for research and development for customers, principally the United States Government.
- During the past ten years, Sperry's own expenditures for research and development have tripled. Its R&D expenditure per employee has gone up 272%.

- Only a dozen corporations in the United States spend more of their own money on R&D than Sperry.
- But just as significant as that is the fact that 66% of Sperry's R&D budget is for computers. It is, perhaps, symbolic of the computer industry's incredible development that just one company, Sperry, is spending nearly a thousand times more money on research than ENIAC cost ($400,000). And, of course, hundreds of other companies are spending millions more.

Because of Sperry and other science-based companies, plus a healthy Government attitude and commitment (at least in the past), this country generally has shown an exceptionally rapid growth in its R&D expenditures. In 1951, only 1% of the gross national product was spent on R&D. By 1964, it was up to 3%.

From the end of World War II until 1965, the GNP tripled. But expenditures for R&D multiplied fifteen times. During that same time-frame, as you know, this country had the greatest economic growth of any nation in history. This was accompanied by political and economic stability, positive trade balances, rising productivity and many other effects.

The result, naturally enough, was that the United States became a symbol for other developed nations of what organized R&D could do. Most of them set R&D targets that would close the gap between them and us in terms of the amount of GNP spent on innovation.

During the '50's and early '60's, the public attitude toward R&D, innovation and technology was positive and very supportive. You'll recall that Sputnik-I was launched in 1957. In the wake of that there was a great surge of public interest in science and, in turn, education. This was reflected in great advances in government and industrial commitments to scientific and educational programs. The capstone of this was the lunar landing program.

But then, about 1969, the U.S. research and development enthusiasm began to wane. Since then, by most statistical measures, U.S. R&D commitment has been eroding.

The National Science Foundation has reported that in the decade from 1967 through 1977, the annual rate of change in R&D expenditures (measured in 1972 constant dollars) has actually been minus 0.2%.

In terms of GNP, R&D expenditures are now about 2.6%, compared with the peak penetration of 3.0% in the mid-sixties. This slow erosion has been masked by the superficial appearance of growth. But, because of inflation, the $77 billion national R&D commitment this year buys little more than the 1970 commitment. In fact, in real terms, the R&D commitment has been generally flat since the sixties.

Industry generally is appreciative of the initiative President Reagan's tax program has taken to provide more incentives for research and development. It is an important first step, but only one among many.

For example:

- The Federal Government's own funding of research and development has been lagging in real terms.

In 1940, 2% of the Federal budget was for R&D. By 1953, the share was up to 4%. By 1960, it was 8% and it peaked in 1965 at a little more than 12%. Since then, the share has diminished to a level of about 5.2% in the fiscal '82 budget.

In any case, the important point is, as underlined by a great deal of research into the sources of economic growth, that research and development is responsible for approximately 60% of all real productivity gains. If we don't invest sufficiently in R&D today, we will surely pay a productivity "cost" in the future.

An example of these threshold technologies that promises future payback for the American economy is computer-integrated manufacturing. Cim will enhance the use of factories through improved quality, lower unit costs and increased responsiveness to markets and customers.

The computer-integrated facility of the future will consist of modular sub-systems, each controlled by a computer which is interconnected to form a distributed system. Computer-integrated manufacturing is composed of two major modules:

- The Computer Aided Design (CAD) module automates the entire design process from finite element studies through drafting.
- The Computer Aided Manufacturing (CAM) module provides for the automation of manufacturing planning, tool design, parts processing, numerical control, assembly and acceptance testing.

In sum, these systems will provide computer aid to all business functions from marketing to product shipment.

Other exciting new technologies that will impact the overall level of United States productivity will be the commercialization of the fuel cell, solar energy and lasers.

Two other emerging technologies also should be identified; namely, artificial intelligence and robotics.

Artificial intelligence will center on large-scale computer power and very sophisticated software which will allow machines to learn and modify their behavior based on external stimuli and built-in protocols.

Robotics will accelerate modernization of present factories by improving not only the quality of work life for employees, but also by enhancing the quality of products for customers. These technologies, in turn, translate into progress and productivity by means of the other two parts of the triangle, capital investment and individual development.

Capital Investment

One of the characteristics of high-technology industries is that they invest not only in research and development, but also in the plant and equipment to take R&D to the marketplace in the form of products or services. In most cases, this plant and equipment investment must also represent the very newest in technology.

For example:

- In Eagan, Minnesota, Sperry Corporation has under construction a new plant which will manufacture some of the world's most advanced electronic microprocessors. These will go into computers and other data processing products of tomorrow. These devices are called very large scale integrated circuits (VLSI). And, on a tiny silicon chip, each must carry tens of thousands of components to do the work. But, in order to manufacture these extremely small complex circuits, we must invest in the newest, most advanced kind of equipment available: in this case, equipment to do electron beam lithography.

One consequence of this need for very high technology in production is that Sperry's annual expenditure for plant and equipment is five times higher than it was a decade ago -- as contrasted with American manufacturing industries generally where the investment in new plant and equipment is only about three times greater than in 1972.

We can see the relative impact of innovation in some annual growth rates measuring high-technology against low-technology industry between 1950 and 1974:

- The growth rate in sales of high-technology industries was nearly triple that of low-technology industries (6.7% versus 2.3%)
- Productivity gains were more than double in high-technology versus low-technology (4.0% versus 2.0%).

In Sperry Corporation, where rates of investment in research, development, plant and equipment have increased very substantially over the past ten years, there also has been a large rate of growth in revenue per worker -- about triple -- from $21,800 in 1972 to about $62,347 in the current fiscal year. This represents an annual productivity growth rate of approximately 12%.

- Employment gains were even more impressive. The rate of change in this sector is nearly nine-to-one in favor of high-technology (2.6% versus 0.3%).
- And, high-technology industries shared their productivity gains with the general economy by holding price increases to one-sixth the increases of low-technology groups (0.5% versus 3.0%).

Further data and studies indicate that this trend continues. During this same time, the growth of gross domestic product (revenue) per non-financial corporate business worker in the United States has about doubled. Obviously, assuming Sperry is representative of a high-technology industry, the productivity gap between high-technology and other forms of non-financial business is widening.

People

The third and most important part of the productivity triad is the individual. Obviously, the functioning of the other two is wholly dependent on the third.

High-technology industries are much more dependent upon improvement in personal skills, education and experience than are other kinds of business. This is because both the nature of their product and their performance center not only on information processing -- the case with many industries -- but also on the expansion and transfer of knowledge at a consistent and rapid rate, via research, development and communication.

This is reflected, for example, in the employment profile of the computer industry:

- 44% of employees are professional or technical;
- 13% are managerial;
- 15% are clerical;
- 22% are plant workers;
- And the balance is in a variety of areas.

Compare that with industry generally:

- 14% of employees are professional or technical;
- 11% are managerial;
- 16% are clerical;
- 34% are plant workers;
- And the balance is in retail sales, laborers or other employment.

In Sperry's computer operations, the employment of professional and technical workers is even more striking -- representing 57% of the workforce. Some 52% of Sperry Univac workers have attended college.

The proportion of so-called "white-collar" workers in Sperry operations is growing. Over the past five years, Sperry's United States white-collar workforce has grown by 79% while its "blue-collar" workforce has grown only 13.8%.

In the future, the profile of the American workforce, especially that in manufacturing, is going to look more and more like high-technology industries' profile today.

If we extrapolate the basic demographic trends of the past twenty years, we get this profile of the U.S. workforce at the end of the century:

- White-collar workers will comprise 58%;
- Blue-collar workers will account for 29%;
- Service workers will be 11.5%; and,
- Agricultural workers will make up 1.5%.

Now, those are simple projections. Some futurists predict that the white-collar share of the workforce will be closer to 70% with the difference coming from the blue-collar and, to a lesser degree, from the service sectors.

Peter Drucker predicts that eventually blue-collar employment in manufacturing will account for no more than 3 to 6%. This forecast of blue-collar participation in the future workforce may appear extreme, however, there is a historical precedent in the United States, namely the dramatic impact of technology and mechanization in agriculture.

The invention of such farm machines as the harvester, the tractor and the one-man hay baler -- invented by Sperry's New Holland Division -- freed labor from the land. A little over a century ago (1870), agriculture accounted for more than half of the United States workforce. By 1900, it was down to 37%. And, that share has continued to drop until today when it is less than 3% of the workforce. Yet, agriculture produces incredibly more today.

Sperry is proud that its New Holland Division has served, and continues to serve, this sector of industry by helping to reduce farming costs, and at the same time, keeping the cost of food for the American family low. This is another example of how high-technology -- in this case in farm equipment design and manufacturing -- has contributed to overall economic well-being.

The point is that dramatic changes in the workforce brought about by technology, innovation and investment have long-range and far-reaching beneficial effects.

But this does not mean that the implications of dislocation can be ignored. Raw data projections of labor force changes fail to indicate the significant character of these changes which will materially affect not only relationships, but the way business is carried out.

Increasingly, production will come from a white-collar workforce of scientists, engineers and technicians interfacing directly with the tools of output. As you know, that is accomplished in some sectors of production today and the trend is clearly for more. In that situation, the skilled blue-collar craftsman turns into a white-collar technician or supervisor.

The transition will be from jobs that are dangerous, boring and which offer little in the way of job satisfaction. New tasks for the employee may consist of programming robots, maintaining automated systems and/or making management level decisions through the use of distributed "user friendly" data processing.

Sperry markets such a system today called MAPPER, which is an acronym for Maintaining And Preparing, Processing Executive Reports. This is an interactive non-procedural report-processing system. It can be operated with simple English language commands, after minimal training. It facilitates dynamic report updating and the execution of new reports for immediate decision-making.

Does this mean armies of unemployed blue-collar or clerical workers?

The historical evidence indicates the answer is an absolute "no" and most contemporary analysts are in full accord with that view.

Sperry, for example, is one of the nation's leading exporters. In our fiscal year ended last March 31, our United States exports amounted to more than $790 million and 70% of that was in high-technology. The remainder was in agricultural equipment and hydraulic components which, while state-of-the-art in their own sectors, are not generally counted by analysts as high-technology.

Sperry's export growth rate has been rapid, rising, doubling our volume in just five years. Our five year aggregate exports amount to nearly $3 billion. That's not only a substantial contribution to the national merchandise trade balance, but also led to the creation of thousands of new jobs in this country.

We are now less than twenty years from the end of this century. During the past twenty years, when technology was growing very rapidly, as was the economy most of the time, our society added more than 32 million jobs, an increase of 50%. Our total population increased only 24%.

In the future, in jobs that we think of as essentially blue-collar -- crane operator in a steel mill for example -- the worker will singly be accountable for the functioning of millions of dollars worth of equipment handling more millions of dollars worth of product every day.

These kinds of transitions and work task revisions will require very significant investments in people. There is a clear need to identify organizational mechanisms that will guarantee the continuous upgrading of skills in the labor force_as we move from one plateau to another.

It also should be recognized that the developmental training must be aimed not only at blue-collar workers, but at all levels of employment if we are to get the optimum in productivity.

For example, American management is also going to have to learn some new skills and enhance some old ones. The focus is going to have to be directed on planning and executing consistent strategies; moving away from the short-term results mentality; and, building cohesiveness and credibility among employees.

High-technology corporations like Sperry are very heavily involved in this process today.

Sperry provides extensive training programs not only for our customers learning to use advanced systems such as computer aided design and computer aided manufacturing (CAD/CAM), but also to upgrade the skills, education and general capabilities of our employees. For example, one of our divisions has a post-graduate electronics course catalogue which would rival that of a large university. We have specific needs for that kind of education and we have to make certain that we have it available to us.

But in all cases, the worker will have to upgrade his or her capabilities to handle increasing accountabilities. And, if management wants to assure itself of such capabilities, it will have to make certain the educational and training systems are financed and functioning the way they should. Today, they are borderline. My company and probably many others count many shortages of people trained in certain skills and disciplines, despite the recession.

The implications of this are quite clear -- there will be a continuing wave of dislocation in the workplace as newer and newer technology is introduced at faster and faster rates.

That decision will impact all parts of the workplace, including the highest levels. So, while we have a continuing shift of people from "blue" to "white" collar, we also will have many shifts within the make-up of the white-collar force itself. For example, increasing office automation is going to shake-up the way corporate headquarters operate day-to-day.

For example:

- A Booz, Allen and Hamilton study found that the white-collar workforce generally is working only at 40 to 60%

of productive capacity and that senior executives commonly spend 20 to 30% of their time on lower level administrative tasks that automated offices could reduce drastically.

- The study indicates that U.S. companies will spend about $725 billion in the 1980's on white-collar operations. Without broad use of automated office technology, the overall cost is expected to soar to some $1.5 trillion by 1990. By adopting new technology, U.S. business can expect a productivity dividend or cost reduction of some $300 billion annually by the end of the decade.
- Other studies have shown that a white-collar worker's productivity can be increased by as much as 15% by 1985 if managers and other professionals fully use automated office tools.

The important thing to remember in this process is that most people feel threatened by change. As a consequence, they feel particularly threatened by the possibility that some piece of hardware is going to come in [illegible] their living away from them. This is an old problem.

You've all heard the story of the Luddites. It has been repeated in many different ways and places since the 19th century. Yet, if history teaches us anything, it is that technological change creates jobs, opportunity and wealth. Certainly, the electronic computer industry is an illustration of that. From a workforce of perhaps two dozen people in 1946, the industry today employs hundreds of thousands of people worldwide. It is the fifth largest manufacturing industry in the United States. In 1981, the data processing and business equipment industry had a net trade surplus of nearly $7 billion, up 14% over 1980. In myriad ways, it is improving both the explicit standard of living and implicit quality of life.

But facts like that don't change the personal apprehension of change because there is a corollary. Technology and innovation do impact jobs and livelihoods negatively as well as positively, even though the balance is overwhelmingly positive.

So, it is this natural apprehension about technological change multiplied by a few negative realities which will create troublesome problems for workers in all sectors of enterprise.

That situation will interact with and reflect many other major influences on the future workforce.

First, there will be substantial demographic changes in populations. The population of the United States is projected at 260 to 280 million in the year 2000. We will have an aging population, meaning an aging workforce. The median age will rise from the present thirty years to about thirty-five years. Implicitly, that means a more experienced workforce. The population of trainee-aged people will shrink from the present 21% share (people 14 - 24) to 16%. Because that age group traditionally has high levels of unemployment, we can expect (other things being equal) that demographic changes will have a favorable effect on some unemployment problems that we must cope with today.

Another demographic factor will be continued immigration into this country. When other nations' critics assess our economy, they frequently talk about the failure of our system to defeat unemployment. But they overlook the fact that we have absorbed more than ten million immigrants since World War II, plus accommodating a very substantial growth in native population. In addition, there is an unknown number of illegal immigrants, perhaps millions.

So, another major influence on employment will be the ability of our economy to continue to create jobs.

Even though we now have an unacceptable level of unemployment, the economy has consistently been creating jobs.

But, in the next twenty years, we will have to add more than forty million jobs.

Tens of millions of women have entered the workforce and that trend probably will continue, given current social patterns. One consequence of this is that the United States now has the highest participation rate of any non-communist industrial nation. (Participation rate is the number of people counted in the workforce as a percentage of working age population. Presently, it is 64% in the U.S.)

More and more of the jobs we will be creating will require high levels of formal education, job skills and experience. Our aging workforce implicitly will provide the experience. But, the other two elements will have to be provided by individuals, business or society. In fact, that has been the mix to date with society carrying most of the burden via public education.

The fact is that as we move deeper into the Age of Information, all of industry here and abroad will be -- or will employ -- high-technology.

The ratio of professional and technical personnel to managerial people will be growing consistently in the years ahead. The share of plant workers will continue to shrink. The classic payroll pyramid we all know is going to turn into something looking like a mushroom with the bulk of the payroll around the top. More than half of the workforce will have had college or other advanced training.

Data underlines the educational trend for the future:

- In 1960, the ratio of workforce to college and university enrollment was twenty to one.
- Today, the ratio is less than nine to one. We have a record college and university enrollment of 12.3 million and, perhaps as significant, women outnumber men on campus by 52% to 48%.

Conclusions and Recommendations

In the foregoing brief discussion, it has been the objective to show that:

- Productivity and technological changes derive directly from a heavy commitment to research and development.
- That these positive changes are put in place via continuing investment in new plant and equipment.
- And, that they are made effective by a workforce whose skills, education and experience continue to progress.

It is the view of the Sperry Corporation that it is clearly in the best interest of the United States to advance all three parts of this productivity triad by creating national policies and/or law which would:

- Encourage greater private sector and Government expenditures on research and development. Specifically, we believe it should be a national goal to have an aggregate national R&D expenditure equal to 3% of gross national product, the level reached a generation ago and since eroded.
- Provide still faster recovery of capital invested in new plant and equipment -- implementing technological changes.
- Encourage and support a manpower policy which guarantees that the workforce will be trained and educated in the application and use of new technology.

Senator **Quayle**. It certainly has been a help. Thank you very much, Mr. Dallob.

Mr. Merchant.

Mr. **Merchant**. Thank you, Mr. Chairman.

I am Dr. M. Eugene Merchant, principal scientist of Cincinnati Milacron. My firm is primarily a manufacturer of capital equipment, such as machine tools and plastics processing machinery, for the manufacturing industry.

So, I will direct my remarks to productivity and manpower considerations in the manufacturing industry, an industry which is on its way to becoming the highest technology sector of industry, and thus the most knowledge intensive sector as well, as I will illustrate.

I will start by addressing the relationships which exist between real national wealth, manufacturing productivity, full employment, and manufacturing technology.

As has been pointed out in a position paper developed by the Society of Manufacturing Engineers in 1978, manufacturing is responsible for approximately two-thirds of the real, tangible wealth that is created annually in this country.

That fact derives from the statistics on gross national product. This situation is as follows:

Manufacturing accounts for about 24 percent of GNP, the extractive industries—agriculture, fishing, mining—and construction industries together account for approximately 13 percent of GNP, and services account for the remaining 63 percent.

A high level of services is, of course, absolutely essential to support a high quality of life and a high standard of living in a nation. However, services do not create real wealth. That comes from the goods-producing sector of the economy; the manufacturing, and the extractive and the construction industries.

If one subtracts out the contributions of services to the GNP, then that 24 percent that manufacturing contributes to GNP, becomes 65 percent, meaning that manufacturing is responsible for approximately 65 percent of the real wealth being created in the country today.

Let us now carry these facts a step further and examine their implications for the future of our country's economic and social well-being.

Because services do not create real wealth, they are dependent on the real-wealth-creating sector of the economy for their support. So, since a high level of services is essential to support of a high quality of life and a high standard of living, further increases in quality of life and standard of living must come from increased cost-effectiveness in the creation of the Nation's real wealth by the goods-producing sector of the economy.

Further, since the goods-producing sector of the economy creates the real wealth of the Nation, the support of employment throughout the economy derives essentially from that sector. So, again, further increases in the level of employment and the rate of creation of new jobs must come from increased cost-effectiveness in the creation of the Nation's real wealth by the goods- producing sector of the economy. Thus continuing increase in cost-effectiveness in the goods-producing sector of the economy is basic to continuing increase in the economic and social well-being of the Nation.

With manufacturing accounting for two-thirds of the creation of real wealth taking place in that sector, development of increased cost-effectiveness in manufacturing must have top priority in national efforts to improve our Nation's economic and social health and well-being.

How does one go about increasing the cost effectiveness of manufacturing? By increasing manufacturing productivity.

How does one increase manufacturing productivity? Primarily, through the improvement of manufacturing technology.

That fact has been substantiated recently by three independent studies of the relative contributions of labor quality, capital growth, and improved technology to improved productivity. These are studies conducted by Denison, by Kendrick, and by Christenson, Cummings, and Jorgenson. This being somewhat subjective matter, those three studies do not agree on quantitative results exactly. However, in each case, or on average, they found that technology is the leading contributor to productivity improvements. In fact, if one takes the average of the three studies, the resulting figures are that, on average, improved technology contributes 59 percent; capital, 27 percent; labor, 14 percent.

So, the prime contributor to increased cost-effectiveness in manufacturing, and so to improvement of the Nation's future economic and social well-being, is research, development, and implementation of innovative, advanced manufacturing technology.

Now, fortunately, a new and highly innovative form of advanced manufacturing technology is being developed and implemented today which, based at least on initial results, has been found to have far greater potential to increase manufacturing productivity than anything which has appeared on the scene since the onset of the industrial revolution. That technology is becoming known as computer integrated manufacturing.

Unfortunately, however, American manufacturing industry has not moved as rapidly as industry in some other countries to implement this highly productive form of manufacturing, as I will illustrate in a moment. But I think I should first briefly characterize for you the nature or the makeup of this new and advanced manufacturing technology known as computer integrated manufacturing, so that you may sense its unique nature.

Computer integrated manufacturing incorporates implementation of such specific innovative, advanced manufacturing technologies as computer aided product design, computer aided process and production planning, computer aided production control, computer-controlled robots and computer-controlled flexible manufacturing systems, and, as well, integration of those through hierarchical factory computer software and hardware systems.

Now, interestingly enough, it is a fact of life that the lion's share of these technologies originated right here in the United States. Yet, sadly, as I implied a moment ago, American manufacturing industry has not moved as rapidly as industry in some other countries to implement the results of that native basic knowledge and innovative manufacturing technology. That situation is not due to the technology not being available from American suppliers. The products of the leading producers of high technology manufacturing equipment in this country incorporate the very latest and most advanced computer integrated manufacturing technology. Yet American manufacturing companies are moving much more slowly in acquiring and applying such equipment than those in some of the other industrialized countries of the world.

Why is that?

The prime cause lies, first of all, in our national failure to recognize the fundamental importance of manufacturing as the major creator of real wealth—its importance to the economic and social well-being of our Nation.

Second, and as a result, of course, it lies in our national failure to marshall joint, cooperative action among our three major public and private sectors, namely government, academia, and industry, in support of manufacturing prowess.

Many other countries do recognize this fundamental importance of manufacturing and so they have marshaled joint, cooperative government-university-industry action in development and implementation of computer integrated manufacturing.

Now let me proceed to illustrate both the power of computer integrated manufacturing to increase manufacturing productivity and the enhancement of its implementation which joint government-university-industry action produces. I will do this by means of two examples. One I will draw from West Germany and one from Japan. Both of these are drawn from the field of metal working manufacturing.

Probably the most advanced and sophisticated computer controlled flexible manufacturing system in the world today is that at Messerschmidt-Bölkow-Blohm in Augsburg, West Germany. It is producing titanium parts for the Tornado fighter plane. Its productivity improvement data is very impressive. The machines in that system are cutting metal 75 to 80 percent of the time, instead of the usual 15 to 30 percent that is obtained normally with standalone machines.

So, that in itself represents excellent improvement of the productivity of the capital investment in that machinery.

The lead time for the Tornado fighter plane is only 18 months compared to 30 months for an equivalent plane produced conventionally.

Comparing the performance of that flexible manufacturing system with producing the same parts with conventional standalone numerically controlled machine tools, one finds that the system has reduced the required number of these numerically controlled machines by 44 percent. That is real productivity improvement of equipment. The required number of skilled machinists has been also reduced by 44 percent. That is real productivity improvement of manpower The required floor space has been reduced by 39 percent. That is striking productivity improvement of facilities. The part flow time in the factory has been reduced by 25 percent—a real improvement in productivity of time. The required capital investment has been decreased by 9 percent—a real improvement of productivity capital.

Quite impressive.

Much of the generic research and development that was required to realize this outstanding accomplishment was carried out in the German technical university research institutes, particularly at Berlin, Aachen, and Stuttgart. And support for that came from government and industry jointly, roughly on a 50–50 basis.

Further, the implementation has been greatly facilitated by a copious supply of manufacturing engineers resulting from strong government-university-industry support of manufacturing engineering education in German universities.

Now the other example from Japan.

Japan has also made great strides in implementing advanced, innovative, highly productive computer integrated manufacturing technology.

For example, at the Kamo works of a little company known as Niigata Converter Co., which is a producer of torque converters, 15 computer controlled numerically controlled machines are running fully unmanned on the two night shifts.

There are some 200 machine tools in that factory, but those 15 machines are handling 29 percent of the factory's workload. That makes them then nine times as productive as conventional numerically controlled machines.

That same innovative, advanced manufacturing technology is now being applied by quite a number of other Japanese companies to accomplish even more startling improvements in manufacturing productivity.

That kind of rapid and effective implementation of computer integrated manufacturing by Japanese industry has been greatly facilitated by the strong tax and capital investment incentives which the Japanese Government offers to companies which carry it out, and these incentives are rather specific to implementation of advanced computer integrated manufacturing type manufacturing technology.

Furthermore, this implementation again is greatly aided by the strong emphasis which the Japanese Government, academia, and industry put on both manufacturing engineering education and industry-oriented generic research in manufacturing at Japanese universities.

I think I would be remiss if I did not also point out the relation of this implementation of highly productive computer integrated manufacturing capability in Japanese industry to the competitiveness of Japanese manufactured products in our markets. That competitiveness has often been attributed to unusual capability on the part of the Japanese to be more innovative in new product development. However, if one looks carefully at the new products from Japan which are satisfying an increasingly large share of our American markets, one finds, on average, that they are no more technologically advanced nor innovative than the products of American companies. Instead, the main advantage that they have is that they are, on average, lower in cost and higher in quality than similar products produced by American companies. That advantage stems directly from Japanese companies' implementation of more advanced manufacturing technology, namely computer integrated manufacturing technology.

I want to emphasize again, in closing, that the lion's share of the innovative technology that is being put to use in these examples that I have given originated in this country. It is equally important to emphasize that it is absolutely impossible to prevent such transfer of technology to take place in this day and age. Instead, what we must do in this country is to take steps to insure that we run faster, and not slower, than the rest of the world, not only in researching and developing innovative, advanced manufacturing technology, but in implementing it in our own manufacturing industry.

The actions which I believe are needed to accomplish this are:

First, improve government incentives to industry to implement computer integrated manufacturing technology, as through tax write-offs, not only for capital equipment but for software—manufacturing software, greatly improved depreciation allowances, et cetera.

Some progress, of course, is being made by the current administration in this direction, but much more is needed, and in particular, of a character more specific to computer integrated manufacturing, if we are to become competitive with other countries in this respect.

Second, reorient government research and development funding toward benefiting the civilian manufacturing industry, with particular emphasis on generic computer integrated manufacturing, research and development, performed primarily by universities and industry.

Third, provide mechanisms and incentives for strong joint industry-government support and encouragement of manufacturing-related engineering education and research in American universities and colleges, backed up by strong secondary school educational programs.

For example, full implementation of the Stevenson-Wydler Act, Public Law 96-480, would give the Department of Commerce real clout to help accomplish this.

Fourth, provide mechanisms and incentives for cooperation between labor and industry in implementation of computer integrated manufacturing technology.

For example, assistance and incentives could be provided to encourage joint labor-industry cooperation in the big task of retraining labor for work in computer integrated manufacturing jobs.

Fifth, generate greatly heightened public and labor awareness of the importance to them of advanced manufacturing technology, its implementation in U.S. industry and the role played by university manufacturing-related engineering education and research in this.

Thank you very much.

[The prepared statement of Mr. Merchant follows:]

Senate Subcommittee on Employment and Productivity
Hearing on Declining Growth in American Productivity
March 19, 1982

Statement by Dr. M. Eugene Merchant, Principal Scientist (Manufacturing Research), Cincinnati Milacron Inc.

Mr. Chairman and Members of the Subcommittee. I am M. Eugene Merchant, Principal Scientist (Manufacturing Research) Cincinnati Milacron Inc. My firm is primarily a manufacturer of capital equipment, such as machine tools and plastics processing machinery, for the manufacturing industry. A part of my responsibility as Principal Scientist is to keep abreast, through first-hand knowledge, of the current state of the art and future trends in advanced manufacturing activities throughout the world. This includes both advanced manufacturing technology and the social and economic factors pertinent to its present and future status. I am also a member of the National Academy of Engineering, a member and past-president of the 60,000 member Society of Manufacturing Engineers (SME) -- a potent factor in enhancing manufacturing productivity in this country -- and a member and past-president of the International Institution for Production Engineering Research (CIRP), an elite forum for international exchange of information on manufacturing research-in-progress around the world.

I will direct my remarks to productivity and manpower considerations in the manufacturing industry, which is on its way to becoming the highest technology sector of industry, and thus the most knowledge intensive sector as well, as I will illustrate.

I will start by addressing the relationships which exist between real national wealth, manufacturing productivity, full employment and manufacturing technology.

As pointed out in the position paper "The National Role and Importance of Manufacturing Engineering and Advanced Manufacturing Technology" issued by the Society of Manufacturing Engineers, May 8, 1978, manufacturing is responsible for approximately two-thirds of the real, tangible wealth created annually in the United States. This fact derives from the statistics on gross national product (GNP). The situation is as follows. Manufacturing accounts for approximately 24 percent of GNP, the extractive (agricultural, fishing, mining, etc.) and construction industries account for approximately 13 percent of GNP and services (the "service industries") account for the remaining 63 percent of GNP. A high level of services is of course absoultely essential to support a high quality of life and a high standard of living in a nation. However, services do not create real wealth. That comes from the goods-producing sector of the economy -- the manufacturing, extractive and construction industries. Thus, subtracting out the contributions of services to the GNP, we see that manufacturing is responsible for approximately 65 percent of the real wealth being created in the country today.

Let's now carry these facts a step further and examine their implications for the future of our country's economic and social well-being. Since services do not create real wealth, they are dependent on the real-wealth-creating sector of the economy for their support. Thus, since a high level of services is essential to support of a high quality of life and a high standard of living, as pointed out above, further increases in quality of life and standard of living must come from increased cost-effectiveness in the creation of the nation's real wealth by the goods-producing sector of the economy. Further, since the goods-producing sector of the economy creates the real wealth of the nation, the support of employment throughout the economy derives from that sector. Thus, again, further increases in the level of employment and the rate of creation of new jobs must come from increased cost-effectiveness in the creation of the nation's real wealth by the goods producing sector of the economy. Thus continuing increase in cost-effectiveness in the goods-producing sector of the economy is basic to continuing increase in the economic and social well-being of the nation. With manufacturing accounting for two-thirds of the creation of real wealth taking place in that sector, development of increased cost-effectiveness in manufacturing must have top priority in national efforts to improve our nation's economic and social health and well-being!

How does one go about increasing the cost-effectiveness of manufacturing? By increasing manufacturing productivity! And how does one increase manufacturing productivity? Primarily through improvement of manufacturing technology! This fact has been substantiated recently in three independent studies of the relative contributions of labor quality, capital growth and improved technology to improved productivity. These studies were conducted by Denison, by Kendrick and by Christenson, Cummings, and Jorgenson and are summarized in volume 2, number 6 (June 1978) of Manufacturing Productivity Frontiers, a publication of the Manufacturing Productivity Center of the Illinois Institute of Technology Research Institute. The table summarizing their findings is reproduced below.

CONTRIBUTIONS TO PRODUCTIVITY INCREASES

	Labor	Capital	Technology
Dension	18%	20%	62%
Kendrick	10%	18%	72%
Christensen, Cummings and Jorgenson	14%	42%	44%
Average	14%	27%	59%

It can be seen that in each case, or an average, technology was found to be the leading contributor to productivity improvements.

Thus the prime contributor to increased cost-effectiveness in manufacturing, and thus to improvement of a nation's future economic and social well-being, is the research, development and implementation of innovative, advanced manufacturing technology. Fortunately, a new and highly innovative form of advanced manufacturing technology is being developed and implemented today which, based on initial results, has far greater potential to increase manufacturing productivity than anything which has appeared on the scene since the onset of the industrial revolution. That technology is becoming known as computer integrated manufacturing (CIM). Unfortunately however, American manufacturing industry has not moved as rapidly as industry in some other countries to implement this highly productive form of manufacturing, as I will illustrate in a moment. However, I should first briefly characterize for you the nature of this new and advanced manufacturing technology known as computer integrated manufacturing, so you may sense its unique nature. Computer integrated manufacturing incorporates implementation of such specific innovative, advanced manufacturing technologies as computer aided product design, computer aided process and production planning, computer aided production control, computer-controlled robots and computer-controlled flexible manufacturing systems, as well as integration of such through hierarchical factory computer software and hardware systems.

It is a fact of life that the lion's share of these technologies originated in the United States! Yet, sadly, as I indicated a moment ago, American manufacturing industry has not moved as rapidly as industry in some other countries to implement the results of that native basic knowledge and innovative manufacturing technology. This situation is not due to the technology not being available from American suppliers. The products of the leading producers of high technology manufacturing equipment in this country incorporate the very latest and most advanced CIM technology. Yet American manufacturing companies are moving much more slowly in acquiring and applying such equipment than those in some of the other industrialized countries of the world. Why?

The prime cause lies, first, in our national failure to recognize the fundamental importance of manufacturing, as the major creator of real wealth, to the economic and social well-being of our nation. Secondly and consequently, it lies in our national failure to marshall joint, cooperative action among our three major public and private sectors, namely government, academia and industry, in support of manufacturing prowess. Many other countries do recognize this fundamental importance of manufacturing and thus have marshalled joint, cooperative government-university-industry action in development and implementation of CIM.

Now let me proceed to illustrate both the power of CIM to increase manufacturing productivity and the enhancement of its implementation which joint government-university-inductry action produces. I will do this by means of examples.

Probably the most advanced and sophisticated flexible manufacturing system (FMS) in the world today is that at Messerschmidt-Bölkow-Blohm in Augsburg, West Germany, producing titanium parts for the Tornado fighter plane. Its productivity improvement data is very impressive. The machines in the system are cutting metal 75 to 80 percent of the time, instead of the usual 15 to 30 percent obtained with stand-alone machines. The lead time for the Tornado is 18 months compared to 30 months for an equivalent plane produced conventionally. The system, when compared with producing the same parts with conventional stand-alone numerically controlled (NC) machine tools, has reduced the required number of NC machines by 44 percent, the required number of skilled machinists by 44 percent, the required floor space by 39 percent, the part flow time in the factory by 25 percent and the required capital investment by 9 percent. Much of the generic research and development required to realize this outstanding accomplishment (as well as the development and implementation of other advanced FMS now occuring in West German industry) was carried out in the German technical university research institutes (particularly at Berlin, Aachen and Stuttgart). Support for this has come from both government and industry on a roughly 50-50 basis. Further, this implementation has been greatly facilitated by a copious supply of manufacturing engineers resulting from strong government-university-industry support of manufacturing engineering education in German universities.

Japan has also made great strides in implementing advanced, innovative, highly productive CIM technology. For example, at the Kamo works of the Niigata Converter Company, a producer of torque converters, 15 computer-controlled NC machines are running fully unmanned on the two night shifts. Although there are some 200 machine tools in that factory, those 15 machines are handling 29 percent of the factory's machining load and are 9 times as productive as conventional NC machines. That same innovative, advanced manufacturing technology is now being applied by a number of other Japanese companies to accomplish even more startling improvements in manufacturing productivity. For example, Fujitsu Fanuc has just put into operation an entire factory, for producing parts for robots and machine tools, which operates almost wholly unmanned on the night shifts, employing both unmanned NC machines and unmanned FMS. Yamazaki Machinery Works has put into operation a similar factory for making machine tool parts. Further, taking advantage of the 24-hour operation and great versatility of these computer-controlled machines and systems, these Japanese companies have developed capability to load them with just the mix of parts required in the next 24 hours for assembly of their finished products. Thus work in progress is reduced virtually to zero, freeing up tremendous amounts of idle capital. (In a typical conventional factory, the capital lying idle in work in progress is often equal to a greater than all of the capital invested in equipment in the factory. And that capital equipment itself seldom has better than 15 percent utilization as compared with the 75 to 80 percent utilization obtained in 24-hour unmanned Japanese factories.) Such rapid and effective implementation of CIM by Japanese industry has been greatly facilitated by the strong tax and capital investment incentives which the Japanese government offers to companies which carry it out, these incentives being rather specific to implementation of advanced CIM-type manufacturing technology. Further, this implementation is greatly aided by the strong emphasis which Japanese government, academia and industry put on both manufacturing engineering education and industry-oriented generic research in manufacturing at universities.

I would be remiss if I did not also point out the relation of this implementation of highly productive CIM capability in Japanese industry to the competitiveness of Japanese manufactured products in our markets. This has often been attributed to unusual capability on the part of the Japanese to be more innovative in new product development. Yet, if one looks carefully at the new products from Japan which are satisfying an increasingly large share of our American markets, one finds that, on average, they are no more technologically advanced nor innovative than the new products of American companies. Instead, the main advantage that they have is that they are, on average, lower in cost and higher in quality than similar products produced by American companies. That advantage stems directly from their implementation of more advanced manufacturing technology, namely CIM technology!

It is important again to emphasize, in closing, that the lion's share of the innovative technology being put to use in the above examples originated in this country. It is equally important to emphasize that it is absolutely impossible to prevent such transfer of technology to take place in this day and age. Instead, America must take steps to insure that we run faster, not slower, than the rest of the world, not just in researching and developing innovative, advanced manufacturing technology, but in implementing it in our own industry.

Needed actions to accomplish this are as follows:

a. Improve government incentives to industry to implement CIM technology -- tax writeoffs (not only for capital equipment but for software), greatly improved depreciation allowances, etc. Some progress in this direction is being made by the current administration but much more is needed and of a character more specific to CIM, if we are to become competitive with other countries in this respect.

b. Reorient current government R&D funding toward benefiting the civilian manufacturing industry, with particular emphasis on generic CIM R&D, performed primarily by universities and industry.

c. Provide mechanisms and incentives for strong joint industry-government support and encouragement of manufacturing-related engineering education and research in U.S. universities and colleges, backed up by strong secondary school educational programs. For example, full implementation of the Stevenson-Wydler Act (Public Law 96-480) would give the Department of Commerce real clout to help accomplish this.

d. Provide mechanisms and incentives for cooperation between labor and industry in implementation of CIM technology. For example, assistance and incentives could be provided to encourage joint labor-industry cooperation in the big task of retraining labor for work in CIM-related jobs.

e. Generate greatly heightened public and labor awareness of the importance to them of advanced manufacturing technology, its implementation in U.S. industry and the role played by university manufacturing-related engineering education and research in this.

Senator QUAYLE. Thank you very much, Mr. Merchant.

Mr. Schuh has not yet arrived. And from the great State of Indiana, Mr. Edgar Davis.

Mr. Davis.

Mr. DAVIS. Thank you, Mr. Chairman.

We appreciate the opportunity to be invited to participate in the hearing this morning and will try to be brief but hopefully helpful in our verbal comments.

As you know, Eli Lilly & Co. is a research base corporation headquartered in Indianapolis, Ind., that develops, manufacturers, and markets human medicines, electronic medical instruments, agricultural chemicals, animal health products, and cosmetics.

We have filed a more extensive written statement with the committee in the hope that our statement will be helpful as a matter of the hearing record.

I am accompanied this morning by Dr. John Virts, our corporate staff economist.

Mr. Chairman, we do not pretend to have all the answers to the productivity questions, but we are proud of the Lilly team of employees, scientists, and administrators that have over the years enabled our company to innovate significant new human health and animal products and to lead the U.S. pharmaceutical industry in 22 of the last 25 years. In the 3 years in which we were not No. 1 in this industry, we were No. 2. And on behalf of all of my Lilly associates, we express our pride in that record.

On the other hand, we recognize that we can always do better. So, we appear today as an example of the research oriented segment of the American pharmaceutical industry, as a company that invests a substantial part of its resources in research and development to discover and develop new medicines, medical devices, agricultural chemicals, and animal health products.

Indeed, we spend about one-quarter of $1 billion a year in research and development. That has doubled in less than 4 years. And we spend annually about one-quarter of $1 billion on new capital expenditures, including a recent announcement of a very extensive genetic D. & A. research center in Indianapolis that will cost an estimated $70 million before it is completed. But we are excited about the prospects of that capital facility and the scientists who will man it to discover hopefully new approaches to arthritis, heart disease, and to a wide range of human illness.

Like all manufacturing companies, we are obviously concerned about productivity in much the sense that we have heard this morning. That is, how to manufacture existing products at a lower cost in terms of employee, material costs, and capital investment.

But, Mr. Chairman, for the research-oriented manufacturer, such as Lilly, productivity has a much broader meaning for us and we believe for our country.

Indeed, the role of corporate organizations and management characteristics, as it relates to productivity, may have a very powerful effect on the productivity performance of companies and our Nation in the long run.

The lesson of the Japanese industrial system to U.S. industry in general may be indeed one which must include an analysis of the process of management. And we may be instructive if we pause and reflect upon the process of management in American industry and examine the institutional structures within industry as well as within Government.

Productivity in our industry is measured by the new drugs and other products we develop from the research investments we make and the technology that we develop, which leads ultimately to new products, which hopefully increase the productivity of our citizens to be functional and to contribute in their own jobs and in their own lives to our national productivity asset.

Society as a whole benefits when our research efforts at Lilly are productive because if we are successful in the innovation of products which heal illness or more quickly and more promptly prevent illness, or discover agricultural chemicals or animal health products that reduce farm costs, then we have multiplied our internal productivity contribution through the lives and the energies of those whose products touch their lives.

If I may just call attention to our annual report, copies of which we will file for the record, we are grateful to note in the annual report a variety of significant product innovations, which range from life saving antibiotics produced in the last year; to the potential of human insulin produced from D. & A. technology, which offers the potential of forestalling forever any shortage of insulin that would be created by a shortage of animal glands, the current source of insulin; to the mention of a new and very intriguing drug for the treatment of arthritis that is already on the market in the United Kingdom and Europe and several other countries, which will hopefully allow individuals to lead a fuller and more active and productive life in work jobs; to electronic systems for the administration of antibiotics in hospitals, which would free up the time of nurses to spend more professional time with patients; to animal health products, which are growth stimulants which have generated 20 percent faster weight gain for cattle, with 23 percent improvement in fetus efficiency.

In fact, one farmer in the annual report is described as having saved 270 metric tons of feed on just 1,000 animals, which is a significant indicator of productivity.

And, finally mentioned in the annual report is a fungacide for rice blast, a serious disease for that particular plant, which has demonstrated the ability to reduce the costs by 50 percent of farmers who grow rice in Asia and other corners of the world.

So, productivity is tied, in our judgment, to innovation, which is in turn tied to investment.

In recent years we have become increasingly concerned about the effects of Federal Government policies on productivity in the research-intensive segment of the pharmaceutical industry. We believe these policies may create significant disincentives for companies like ours to invest in research to develop new products.

So, I would like to ask Dr. Virts to briefly discuss this issue as an economist. And then, with your permission, I would like to return and make a very brief summary of our observations and recommendations before we close our statement.

Dr. Virts.

Senator QUAYLE. You may proceed.

Mr. VIRTS. I am going to direct my remarks to the effect of regulation on productivity in the research and development-oriented sector of the pharmaceutical industry and then share with you our thoughts about how the climate for productivity growth can be improved.

Historically the labor productivity of the pharmaceutical industry has increased at about twice the rate of average U.S. manufacturing. The labor productivity of our firm and some other R. & D. intensive and integrated pharmaceutical firms has been even greater, as much as four times the rate of increase of average manufacturing in some time periods.

In order to return the American economy to more acceptable productivity growth, we believe that policy should continue in at least the following two directions:

First, inflation must be reduced and then eliminated. While increasing productivity can lessen the impact of the inflationary process, declining productivity has been one of the results of inflation and not a cause.

Second, regulatory reform must escalate in order to eliminate unnecessary and unproductive costs in both public and private sectors. Such reform, in our opinion, should concentrate as much as feasible on regulating outcomes rather than the command/control form of so many past regulations.

We do agree that progress in improving the climate for investment, including research and development, has been made in the past 12 months or so. However, there is still much more that can be done.

From our particular view, we believe it is important to reexamine the FDA regulation of the process surrounding the approval of new drugs, especially for the totally new drug products based on new chemical entities, those chemicals not previously available for use in human drug therapy. The identification, synthesis, establishment of the pharmacologic properties, conducting of clinical trials, and, ultimately, the design of manufacturing and quality-control processes take years of time and millions of dollars of human and physical resources. Such a process is truly investment in the future, both of the firms so engaged and society.

As revealed in a recent study, 75 percent or three out of four of the new chemical entities coming to market in the United States in a recent 10-year period are not expected to recover this investment, let alone earn an adequate return.

It is important to note, as Mr. Davis said, that new drug therapy and new drug products can be expected to do even more than just enhance the productivity of innovating pharmaceutical firms. Innovations in drug therapy also can conserve, and have conserved, other health care resources, thus enhancing the productivity of people whose work is the care of patients, as well as lessening the impact of illness on the productivity of all workers. Any unnecessary inhibition to that process leads to less potential productivity in society as well as in R. & D. oriented pharmaceutical firms themselves.

We have submitted for the record copies of three studies that assess the impact of regulation on the R. & D. oriented part of the pharmaceutical industry. As R. & D. costs have increased and incentives declined, the number of such firms has been declining, as has the intensity of R. & D. in real terms. Leading U.S. firms have been diversifying away from pharmaceuticals, and foreign-based firms have increased their penetration of the U.S. market. We must find ways to reduce these impacts, but not for the sake of the firms involved, but to improve future societies' opportunities for even more cost-effective health care.

Regulatory time delays are an example of manmade institutions that can adversely affect the availability of new chemical entities to the world's stock of health care technology. In the U.S. prices and costs of 1980, a 12-month delay costs an owner of a new chemical entity roughly $10 million because of inflation and the time cost of investment. In addition, time delays reduce the effective life of a patent. By affecting both the cost and the rewards of R. & D., time delays are potentially serious causes of violations of the public interest in new chemical entities.

Evidence of unproductive regulatory time delay can be seen in the experience of our company. When the seven new chemical entities introduced by Lilly into the U.S. market during the period January 1970, through June 1979, are considered, the following time lag has been measured:

Twenty-three months elapsed from satisfying Lilly's requirements that the product is safe and effective under conditions of use, plus those of a legally established national regulatory authority, to approval in the United States as an approved new drug application.

For nearly 2 years, then, the United States was missing the therapy, as well as the competition, represented by Lilly's average new chemical entity, while the company was missing the opportunity of sales in the United States.

In not one case in that intervening time period was any new data or study produced that called into question, in any negative way, the safety or efficacy of any of the products for the indications for which they were first marketed. In other words, the benefit to the U.S. consumer of whatever costs are implied by the 23-month delay was absolutely zero.

The same time period and definitions were use with data from eight other research-intensive multinationals in a part of the Pharmaceutical Manufacturers Association study of the cost of FDA regulations, which we have also submitted.

For the expanded list of 30 new chemical entities innovated by 9 firms, the analogous time cost is reported to be 18 months.

Another paper in that PMA Cost of FDA Regulation Study started with data on the incremental regulatory dollar and time cost and carried them through to the implication for consumers in terms of lost new chemical entities. The paper concludes: If the incremental FDA regulatory costs and time costs could be eliminated, the output of new chemical entities for these nine companies would increase by 20 to 30 percent each year, an increase of one to two new chemical entities each year, with no loss in whatever benefits accrue to consumers from current regulatory goals and objectives.

An estimate of the impact of regulation on a single company has been also submitted for the record. Adding the Lilly incremental cost data included in the PMA study of the FDA regulations to our company's data included in The Business Roundtable study of six other agency regulations, including the EPA, the result is revealing if not staggering.

If the incremental costs of regulation caused by just these programs could be removed, the annual dollar value of Lilly output per unit of input of labor plus capital would be increased by 6 percent.

We believe that these studies represent very conclusive evidence that regulatory reform, particularly of the FDA new drug approval process, can proceed with no threat to statutory goals of safety and efficacy and achieve very significant contributions to productivity.

We cannot emphasize too strongly that the costs of regulation measured by these studies are costs potentially eliminated with no change in the goals of the regulation, just changes in the means of implementation. Any additional savings in public sector costs would further increase the Nation's productivity. Any additional R. & D. output of new chemical entities or the earlier availability of such drugs would further increase not only the competition for the Nation's health care dollar, but also the productivity of all of the world's people through improved health care.

Mr. DAVIS. Mr. Chairman, we have heard this morning, I think, dramatic evidence that research and development investments, technology and resulting innovation are a precious national asset, strategic in the global sense for the United States from a public policy point of view, from an international competition point of view, and in the long term from the point of view of the well being of our citizens, both physically, economically, and socially. And, therefore, I would encourage us to encourage the most responsible effort to examine institutional structures, both within the corporation and within Government, that insure that all unnecessary inefficiencies that drag productivity are at least considered and hopefully eliminated.

I cite the importance of internal corporate assessments and management process with a view toward insuring that any comments I make with respect to the need for the review of Government institutional structure is done with full knowledge that both the corporation and Government share a responsibility to insure that its institutional operation is most efficient.

We are not alone at Lilly in our concern about the need for reform of the existing new drug approval regulatory process. Vice President Bush's task force on regulatory reform identified the new drug approval process last March in its first list of regulations to be studied. As you know, Congressmen Scheuer and Gore have formed a commission to examine this issue. And under the encouraging leadership of Secretary Schweiker at the Department of Health and Human Services and FDA Commissioner Hayes, we do note that the FDA has formed an inhouse task force to study the new drug approval process.

Lilly, indeed, has submitted specific recommendations to all of these groups, and we will file a copy of our written submissions to these groups with your committee for the record.

While we believe that our recommendations and the work of the study commissions can lead to improvements within the present regulatory system, and thereby contribute to improved productivity, we believe that a far larger question deserves to be more thoroughly and independently studied. Because in a very larger frame the future of health regulation in the United States involves more than the question of timing and in installing improvements in the present regulatory system. If we understand the importance of the negative consequences of continuing the status quo of regulation on productivity, on investment, and on timely availability of new drugs to the public in the United States, as outlined by Dr. Virts, then we must also ask ourselves whether our current regulatory institutions are best structured to deal with the revolutionary changes in current research in such fields as molecular biology, immunology, genetics, artificial organs, medical devices, and other startling innovations that may have a major impact on the future health and welfare of our people.

Neither the Government, the industry, nor the public should assume that our current institutional structures are necessarily perfect for assuring public safety, on the one hand, and prompt efficient review and approval of new scientific innovations on the other.

Indeed, we have evidence in other countries that alternative institutional approaches can provide innovations to the public with less delay and not jeopardize the public's safety.

And so we should, at least, I submit, take the time and invest the effort to objectively examine other models of drug regulation with a view toward structuring the most appropriate future system for the United States. It may well be that such a thoughtful, objective study will not be easy to accomplish because it inevitably questions traditional roles and responsibilities.

But, Mr. Chairman, I am hopeful that such an examination will take place in the public interest, even if we end up confirming the appropriateness and the efficiency of our present Government structure.

I recognize that such an examination is a complex matter. But I hope that the record of your hearings and your future statements on productivity will recognize the significant potential improvement that may lie in a fresh rethinking of our governmental regulatory structures and not simply a fine-tuning of existing regulatory organizations.

We believe that the future era of medical care will require creative new approaches to regulation. Scientific assessments of benefit/risk and the reliability of the new scientific and medical technologies will become even more enormously complex and, thereby, potentially time consuming.

One must question whether or not those institutions that now regulate health care will be appropriate to efficiently oversee the scientific work of academic and commercial laboratories in the future. It is possible to envision institutional structures within Government that would permit drugs to be evaluated for safety and safety-related efficacy by scientists insulated from both industry pressures and the political process.

Indeed, Mr. Chairman, we are intrigued by the accomplishments of the United Kingdom, which is, as you know, a country that has a health-care system, and particularly a health-care financing system, that is based upon a centralized government allocation and distribution of health care. And those features, of course, we would question in relation to the pluralistic private and public health care delivery system in the United States.

Nevertheless, the United Kingdom also has a separate system based upon an interesting philosophy with respect to new drug approval. And that system has made new drugs available to the public in the United Kingdom considerably faster and at a much lower cost to the sponsor, to the government and to the public, than we have in the United States.

The British have done it without sacrificing safety or patient protection. And we are intrigued by their accomplishments, and we believe that much can be learned from their example, particularly from their institutional concepts and structure, which underlie the formation and the history of the United Kingdom's Committee on the Safety of Medicines.

Obviously, we do not propose a transplant of a system that is developed in one cultural setting directly into another country. But we do suggest it as an instructive model.

Thank you, Mr. Chairman, for the opportunity to appear before your committee. We are confident that even greater productivity and public health achievements can be made by our industry and by our company, particularly if thoughtful and constructive regulatory reform does, in fact, take place.

Thank you.

[The prepared statement of the Eli Lilly & Co. and documents received for the record follow:]

STATEMENT OF ELI LILLY & CO., PRESENTED BY EDGAR G. DAVIS, VICE PRESIDENT, CORPORATE AFFAIRS

Mr. Chairman and members of the Subcommittee:

Thank you for your very kind invitation to participate in these hearings on factors influencing productivity. We at Lilly agree that this is a most important issue and commend you for taking time to focus national attention on this subject. We will direct our testimony to the effect of regulation on productivity in the pharmaceutical industry and share with you our thoughts about how the climate for productivity growth can be improved.

Declining rates of growth in productivity have been experienced in all industrialized nations in recent years, with the declines being somewhat more pronounced in our country than in some competitor nations and somewhat less pronounced than in others. Likewise, productivity growth has slowed in most industries, with the declines tending to be less in the so-called high-technology industries.

We believe it is important to distinguish between national levels of output per capita or output per employed person (macroproductivity concepts) and individual firm or industry levels of output per employee (microproductivity concepts). It is important to recognize that the productivity-growth-inhibiting forces operating in our country have caused declining growth rates for both macro- and microproductivity, but for somewhat different reasons in spite of the obvious interrelationships of the two concepts. We will briefly discuss our views on some general aspects of macro- and microproductivity-growth declines. We will then discuss our view of the pharmaceutical industry's productivity-growth environment and suggest some specific steps that can be taken to improve that environment and, thus, the industry's productivity and the productivity of health care.

Comments on Declining U.S. Macroproductivity Growth

The growth of total gross national product (GNP) per capita or per employee is, of course, influenced by the growth of individual industry and private firm productivities but is also dependent on the relative growth of particular industries and, very importantly, by the growth of the public sector itself. Recent history has seen all manufacturing plus agriculture and mining decline from 37 percent of GNP in 1960 to 31 percent in 1980. Such changes alone will probably cause macroproductivity declines in any society because of the lower levels of the value of output per employed person in the services industries. The gradual decline in the average age of the population has probably contributed similarly to such declines--the young, on average, being less productive, both because of the length of schooling in our society and less experience on jobs of any kind.

Especially important is the contribution of the growth of public sector employment in recent years. In 1960 total employment by governments (federal, state, county, and local) was 8.8 million persons, or 12 percent of the total labor force. By 1980 this level had reached 17 million persons, or 16 percent of the total labor force. The "output" of government workers is counted in GNP as their wages. As new social and regulatory programs have been put in place and as older ones, like education, have grown, more and more of the labor force has been absorbed into the public sector.

We make these points only as a reminder of two things in considering the overall problem of declining U.S. productivity growth. First, some of the decline has been "natural" in the sense of reflecting the changing relative demands of consumers for particular goods and services. Second, the efficient use of manpower in the public sector is an extremely important part of any overall strategy to improve productivity growth.

General Industry or Firm Productivity--Output per Employee

To achieve maximum output per employee requires a well-trained and motivated workforce. It also requires management to provide the selection of employees, the business strategies, the environment, and the incentives to let that workforce--including the management itself--achieve satisfaction and growth. Most importantly in achieving growth in productivity, there must be capital to develop new technologies of product and process through research and development and to invest in new and/or expanded production operations.

In our view, the principal problems causing the slowing of the growth of productivity have not been either the American workforce or American management. The problems of the past few years have been in the environment for capital formation--including R&D--and the diversion of capital into uses that do not enhance either output or productivity. Effective management and a well-trained, motivated workforce can minimize costs and maximize productivity only within the constraints inherent in the global economic environment. That environment during most of the 1970s was distinctly unfavorable to the continuing growth of productivity for at least the following reasons:

- The demands for capital to meet regulatory requirements and to shift to less energy-intensive processes diverted capital spending from what might otherwise have been productivity-enhancing projects.

- Inflation, coupled with accounting conventions and tax regulation, by understating the real costs of depreciation and understating the erosion of the value of assets, caused business incomes to be overstated. In effect, we taxed away part of our capital base and reduced the flow of resources to real capital formation while also reducing the real return to capital.

- The combination of inflation and the energy-intensive nature of the production of most capital goods increased the cost of those goods, while cash flows to capital formation and the return to capital were relatively depressed.

- R&D was depressed by several factors from what it might otherwise have been. R&D is labor-intensive, and the inflationary process has raised wages relative to output prices in many industries. Regulation of many sorts--particularly that of the Food and Drug Administration (FDA) for new drug applications (NDAs) and the Environmental Protection Agency (EPA) for product registrations--increased the costs of R&D as available cash flows were being depressed and other costs were also rising.

- Finally, uncertainty about the impact of the future inflationary environment on the costs of capital goods and the return to capital projects, coupled, in many cases, with uncertainty about the course of regulation and the decisions of regulators, seriously inhibited the investment process within firms.

In order to return the American economy to more acceptable productivity growth, we believe that the most efficient policy directions for the future should include:

- Reduction, and then elimination, of inflation. While increasing productivity can lessen the impact of the inflationary process, declining productivity has been one of the results of inflation and not a cause of inflation.

- Deregulation of energy prices to stimulate the search for new sources and to achieve predictability so that the adjustment of production to the new relative cost of energy can be completed.

- Regulatory reform to eliminate unnecessary and unproductive costs in both public and private sectors. Such reform should concentrate as much as feasible on regulating outcomes rather than the command/control form of so many past regulations.

We agree that much progress in improving the climate for investment, including R&D, has already been made. However, there is still much more that can be done. From our particular view as a leading worldwide R&D-oriented pharmaceutical firm, we believe it is important to reexamine the regulation of the process surrounding the NDA, particularly for the totally new drug products based on new chemical entities (NCEs)--those chemicals not previously evaluated for use in human drug therapy. The identification, synthesis, establishment of the pharmacologic properties, conducting of clinical trials, and, ultimately, the design of manufacturing and quality-control processes take years of time and millions of dollars of human and physical resources.

Such a process is, thus, truly investment in the future--both of firms so engaged and society.

It must be recognized, in interpreting this discussion, that there are really two broad types of pharmaceutical firms--the production-oriented and the firms like ours, which concentrate heavily on research aimed at innovating in world markets with totally new drugs. The impact of regulation and other aspects of the general economic environment are very different for these two types of firms. In this discussion, where reference is made to the pharmaceutical industry, we will always be referring to the R&D-oriented segment of that industry.

It is important to note that new drug therapy and new drug products are not only very likely to enhance the productivity of innovating pharmaceutical firms but they also represent productivity increases in their use by professionals in the treatment of patients. Not every NCE coming from industry research has measurably reduced the length or cost of illness or increased the spectrum of treatment of illness, but many have. And the process of R&D orientation, production, and disseminating the knowledge necessary to properly use new pharmaceuticals has improved, and will continue to improve, the productivity of treated individuals. In short, innovations in drug therapy can conserve, and have conserved, other health care resources, thus enhancing the productivity of people whose work is the care of patients as well as lessening the impact of illness on the productivity of all workers. Any unnecessary inhibition to that process leads to less potential productivity in society as well as in R&D-oriented pharmaceutical firms themselves.

Evidence of the Need for Reform of the Regulation of the Pharmaceutical Industry

A recent study (Exhibit I) confirms that return on research and development in the pharmaceutical industry can no longer support the intensive relative growth of research so important to past improvements in health care and industry competition--especially in the United States. In 1976 dollars, the cost of developing a new chemical entity was $54 million. In 1982 dollars, this cost exceeds $70 million. This cost includes the direct accounting costs, an allowance for the probability of developing a new drug--the "dry holes"--the time cost of investment, and inflation.

The study estimated the average revenues on 119 new chemical entities introduced in the United States between 1967 and 1976 and concluded that, for the typical drug compound, "average experience would not represent adequate revenues for R&D investments to earn the cost of capital."

The new chemical entities studied varied widely in cost and returns, confirming both the risk and potential in pharmaceutical R&D investment; 75 percent of the drug might never recover even the direct cost of R&D in current dollars. But 25 percent of the sample appeared to be very successful, the study estimated.

The study reported that, as fewer new chemical entities have been approved, there has been a decline in the number of independent companies achieving new chemical entity marketing and a gradual decline in the R&D intensity, in real terms, of manufacturers generally. R&D has tended to shift from smaller to larger firms and from the United States to other developed countries. Innovation and sales have also shifted from U.S.-owned to foreign-owned firms--and within the firms, a diversification away from pharmaceutical has occurred.

Pharmaceutical marketing has been subjected to numerous forms of regulation and restriction affecting either or both the cost of R&D and the incentives for its pursuit. Regulation has increased all costs, including the cost of R&D. Incentives have been reduced by various mechanisms that direct cash flows--business--away from research-intensive firms or activities in favor of production-distribution firms and activities. Examples are formularies established by Medicaid authorities, the Maximum Allowable Cost program of Medicaid, and the concept of forced generic substitution. No one of these regulations or restrictions by itself did, or perhaps could, cause the extent of the damage we now see to the environment for pharmaceutical R&D. One is reminded of the famous camel, with straw after straw being piled on its back until the inevitable occurs. We must find ways to reduce the number and weight of such straws--not for the sake of the firms involved but to improve future societies' opportunities for even more cost-effective health care.

Regulatory time delays are an example of man-made institutions that can adversely affect the availability of NCEs to the world's stock of health care technology. In 1980 U.S. prices and costs, a twelve-month delay costs an NCE owner roughly $10 million--because of inflation and the time cost of investment. In addition, since the time clock on patents in any country typically starts well before the beginning of studies necessary to meet regulatory requirements, time delays reduce the effective life of a patent and, thus, reduce the rewards. By affecting both the cost and the rewards of R&D, time delays are potentially serious causes of violations of the public interest in NCEs. Legislation to restore the patent term of products subjected to such regulation can restore some of the lost incentives. However, any unnecessary time delays should still be eliminated, since costs will be reduced and incentives enhanced even further. It should be noted that these less-recognized costs of time delay are in addition to the more obvious costs of unnecessary, or marginal, or duplicative testing and patients' loss of valuable therapy.

It must be noted that even the most conclusive evidence of this phenomenon would not necessarily be a reflection on the regulators as either people or regulators. It might not necessarily reflect on the regulations or laws themselves, because of the social and political environment within which laws, regulations, and regulators must operate. Especially since much of the evidence is anecdotal, we cannot seek human culprits, even if that were the objective, which it is not.

Evidence of unproductive regulatory time delay can be seen in the experience of Eli Lilly and Company. The U.S. market has not been the first market to receive the advantages of any new Lilly drug product marketed in recent years. When the company's scientists and management decide that a product is ready for market, Lilly markets the product wherever the existing regulations and regulators have been satisfied.

When the seven NCEs introduced by Eli Lilly and Company into the U.S. market during the period January, 1970, through June, 1979, are considered, the following time lag has been measured:

> For the average of these seven drugs, the time lag was twenty-three months--from satisfying Lilly's requirements, plus those of a legally established national regulatory authority, to approved U.S. NDA status.* For nearly two years, then, the United States was missing the therapy, as well as the competition, represented by Lilly's average NCE, while the company was missing the opportunity of sales in the United States.

In not one case in that intervening time period were any data or studies revealed that called into question, in any negative way, the safety or efficacy of a product for the indications for which the product was first marketed. In other words, the benefit to the U.S. consumer of whatever costs are implied by the twenty-three-month delay was absolutely zero.

---

*The lags for the seven NCEs ranged from 9 to 65 months. When the very unusual 65-month lag is removed, the average lag for the other six drugs was 16.5 months.

Martin Eisman and William Wardell, of the University of Rochester, have used the same time period and definitions but added data from eight other research-intensive multinationals in a paper recently published as part of the Pharmaceutical Manufacturers Association (PMA) study of the cost of FDA regulations (Exhibit II). For the expanded list of thirty NCEs innovated by nine firms, the time cost analogous to the twenty-three months reported above is reported to be eighteen months.* For the same thirty NCEs, Eisman and Wardell measured the time cost of U.S. FDA regulation relative to that in countries with varying degrees of regulatory stringency approaching that of the FDA. In each case, a greater time cost for the U.S. market is demonstrated. Eisman and Wardell conclude that, conservatively, the cost in months of unnecessary and unproductive delay for the average NCE should probably be estimated as fourteen months, based on the data used.

One must conclude that fourteen to eighteen months of delay in the availability of the average new drug for the treatment of U.S. patients can be eliminated without any change in the risk/benefit ratio of the regulatory process.

---

*Any delays caused by a company's inattention to the particular NDA or other slowing of the process for any reason were subtracted from the measured lags.

The cost of regulation as practiced in the United States in so many forms has been the recent subject of not only political discussion but also academic and empirical research. Arthur Andersen and Company and The Business Roundtable (BRT, utilized a concept called "incremental cost" to measure unnecessary cost of regulation. This technique poses two questions to business managers in very detailed accounting language: First, how much do you spend to implement a specific governmental regulation? Second, how much would you spend to achieve exactly the same goal as required by the regulation if you were free to do so without being regulated into specific actions and paperwork? The difference between these two costs is "incremental cost" of regulation. It should be emphasized that such studies, therefore, are not questioning the merit of the goals of regulation, just the manner of implementation. If the regulatory goal itself were questionable, then total cost, not just incremental cost, could, possibly, be eliminated. Specific dollar-cost numbers so developed are, of course, subject to the judgments of business managers--but reflect cost of regulation without benefit and are, therefore, of great interest, both in diagnosing macroeconomic problems like lessened productivity growth in the United States and in finding activities that need to be reregulated. Most analysts feel that the accounting methodology tends to understate true unnecessary costs of regulation. Especially if this is so, the empirical results are disturbingly large.

Nine member companies of the PMA participated in the previously mentioned study of such "incremental costs" of FDA regulations for the year 1978. In this study, the incremental costs were determined for the nine companies, regulation by regulation. The companies account for about 30 percent of U.S. sales of ethical pharmaceuticals and 40 percent of the research activity related to ethical pharmaceuticals. Important to this discussion, the incremental cost of FDA regulation of the R&D activities concerned with the search for and development of NCEs for just these nine companies in 1978 was $34 million of the total $117 million of FDA-regulation incremental cost. In turn, this $34 million of unnecessary R&D cost was 9 percent of the $376 million expended in 1978 by the nine companies in R&D for NCEs.

As part of the PMA Cost-of-FDA-Regulation Study, economist Ronald Hansen, of the University of Rochester, started with the incremental cost data and carried it through to the implication for consumers in terms of lost NCEs. At every stage of the analysis, conservative procedures were selected. The regulatory-time-delay costs discussed earlier were also brought into the analysis. The analysis concludes the following: If the incremental FDA regulatory costs and time costs could be eliminated, the output of NCEs from these nine companies would increase by 20-30 percent each year--an increase of one to two NCEs each year, with no loss in whatever benefits accrue to consumers from current regulatory goals and objectives.

Another interesting attempt at roughly positioning the impact of regulation on a single company has been made in a published paper by one of our economists (Exhibit III). This paper used the Lilly incremental cost data included in the BRT study of EPA, FTC, OSHA, EEOC, ERISA, and DOE regulations, with the PMA study of FDA regulations, to estimate the impact of these incremental costs on Lilly productivity. The study estimates that, if the incremental costs of regulation caused by just these programs could be removed, the annual dollar value of Lilly output per unit of input of labor plus capital would be increased by 6 percent.

We believe that these studies represent very conclusive evidence that regulatory reform--particularly of the FDA NDA procedures--can proceed with no threat to regulatory goals and still achieve very significant contributions to productivity. The judgment of business managements, audited for definition and consistency by either an independent accounting firm or recognized academic researchers, is involved, to be sure. The measured impact on one firm's productivity, however, is clear and recognizably conservative. We cannot emphasize too strongly that the costs of regulation measured--extra R&D cost, extra time cost for new drugs, extra labor cost, extra capital cost--are incremental. This means costs that potentially can be eliminated with no change in the goals of the regulation, just changes in the means of implementing various regulatory initiatives. Any additional savings in the public sector would further influence macro-productivity. Any additional R&D output of NCEs or the earlier availability of NCEs would further increase not only the competition for the nation's health care dollar but also the productivity of all the world's people, especially those in the United States, through improved health care.

Productivity Enhancing Regulatory Reform for the Pharmaceutical Industry

Lilly is not alone in its concern about the need for deregulation of the new drug approval process. The Task Force on Regulatory Reform, headed by Vice President Bush, identified the Investigational New Drug (IND) and NDA process on its first list of regulations to be studied. Congressmen Scheuer and Gore, concerned about the lag in the availability of medicines to consumers in this country, have formed a commission composed of consumers, academicians, and representatives from government and industry to make recommendations to improve the approval process. Further, Secretary Schweiker of HHS and Commissioner Hayes of FDA have formed an in-house task force to study the issue and to propose changes to accelerate the approval of new medicines. Lilly has submitted its recommendations to each of these bodies and is, of course, hopeful that those efforts will produce meaningful reform.

For the record and for your consideration, attached are copies of our specific recommendations to the groups just mentioned (Exhibit IV). We are also suggesting for your consideration some broader organizational concepts and directions for FDA and FDA-like regulation (Exhibit V).

As we perceive the situation, there are two inherent problems with current regulation that should be addressed in working toward both macro- and microproductivity-growth enhancement:

1. The concepts of clinical safety and effectiveness, while clearly related to the economics of maximally cost-efficient treatment, must be completely separated from economic considerations in the regulation of new drug applications.

2. Many of the natural motives and incentives

> of bureaucratic regulatory agencies, especially in a political environment, are strong forces inhibiting the cost-effectiveness of new drug regulation.

Clinical safety and clinical effectiveness are obviously related, for if the patient takes an ineffective drug he or she fails to receive the benefits of effectiveness, and that failure may affect the patient's health and well-being. Rare indeed, however, is the case where relative clinical risks over a spectrum of drugs are so high that relative effectiveness must be scientifically judged before a new chemical entity can reasonably be placed in the hands of trained practitioners. Overuse of comparative testing has resulted, we believe, from the perceived need of regulators to establish not only when a new chemical entity can be safely used but whether it should be used. The latter question is not necessarily more complex than the former, but it requires different kinds and volumes of data. The delays and costs involved in the marketing approval process have been a principal cause of the reduced availability of, and competition from, new chemical entities. The economics of the R&D process have, thus, deteriorated because of regulatory concentration on the short-term economics of product use.

Reference to the bureaucratic should not be taken as a slur on bureaucracies as such. We all are involved in bureaucracies of one kind or another. Bureaucracies, private and public, can be an efficient form of organization if constrained and assigned an applicable problem. However, bureaucracies tend to maximize their own budgets and span of control, while also maximizing their visible output and minimizing their detectable errors, and this is, above all, true of public bureaucracies.

Thus, it has been natural for the Food and Drug Administration, operating in a highly political environment, to develop in the fashion it has, simply because it has had a mandate without sufficient control. It has sought to do more and more for the political constituencies it served and to conduct its activities in ways that almost always permitted any blame to fall either on its mandate or on some other actor in the drama. The essentially scientific questions involved in the issue of the public's safety when exposed to a new chemical entity on the market are simply not amenable to complete bureaucratic control. The administration of the process is a natural bureaucratic model, but the decision-making is not. That's been the rub, as far as the cost-effectiveness of regulation in the United States is concerned.

It is obvious that there is an urgent need for change in the pattern of drug regulation in order to achieve the goal of protection of the public. Even more obvious is the fact that change must be evolutionary rather than revolutionary. Changes like those outlined in Exhibit IV can and should be made while the debate continues on what further changes should be made. We will summarize what we believe are the most significant for productivity enhancement.

First, we believe that Phase I trials should be conducted before, and not after, submission to the FDA of an IND (Notice of Claimed Investigational Exemption for a New Drug). Phase I trials, which follow and are accompanied by animal toxicology tests, involve testing of small quantities of the substance, usually in healthy human adult volunteers, in order to determine physiological action and response. This is the safest part of drug testing: the population at risk is very small, usually about a dozen, and the quantities of chemical are typically minute. But the cost of submitting the test records and results to the government are very high and must now be incurred for all entities, whether they progress into further trials or not--and the great majority do not. Therefore, we propose that the institutional review boards (IRBs), now in place at virtually every major medical center in the United States, alternatively be given the responsibility for overseeing the conduct of Phase I trials. This proposal is not intended to limit FDA oversight of broader trials for those few compounds that progress to New Drug Application status.

Second, we urge the elimination of the thirty-day "hold" after submission of the IND. The work of the IRB in supervising the Phase I trials would make such a waiting period unnecessary.

Third, with respect to the New Drug Application itself, the FDA should accept summaries of pertinent data instead of requiring, as it does now, the submission of great mountains of paper, the raw case histories and other records for patients involved in trials, who may sometimes number in the thousands. Since drug sponsors are required to maintain all of these records indefinitely, random audits of the raw data should enable the FDA to have confidence in the summaries.

Fourth, strong action should be taken to ensure that the statutory 180-day period for review of an NDA submission is adhered to. The agency must provide greater justification for extensions than has been the experience since the law was changed in 1962. In enforcing this statutory period, we will be acknowledging--as Congress did when it put the FDA under a 180-day deadline--that the incentives for regutendency to tell the pharmaceutical industry when to sow and when to reap, and the result has been a decline in the number of needed new medicines reaching patients as well as other losses of potential productivity growth.

Conclusions

While the current general economic climate tends to cloud the view of any of us, we do believe that our country has embarked on an economic reform program which will prove, in time, to be to the advantage of the economies and societies of all countries. We believe that the climate for investment will become significantly better than it was in the decade of the seventies--and clearly better than it would otherwise have become. The stimuli and incentives for R&D have been enhanced. One piece of evidence of this is the recently announced decision by our company to begin very soon the construction of a major new research facility in Indianapolis. In short, we believe that many forces toward improved U.S. productivity growth have been set in motion. With the improvement will come improved competitiveness of U.S. firms in international markets.

Regulatory reform, however, must be firmly directed and speeded up if we are to reach our full potential for enhanced productivity growth and international competitiveness as far latory officials are toward caution. There is no positive encouragement--except for the 180-day limitation, which is always ignored--to foster prompt decisions. These factors also favor delay, while patients in need of the medicine under consideration do without it.

Fifth, there should be greater reliance by the FDA on outside scientific committees. Such committees are drawn from the ranks of recognized experts in a given specialty. Such outside scientific committees should be used to settle scientific disagreements between the pharmaceutical company and the FDA. The committees also should be relied upon to inform the FDA when the safety and safety-related efficacy of a new chemical entity have been tested sufficiently to permit marketing.

These recommendations can be implemented under existing law through regulatory and attitudinal changes. The gains may be very great, indeed.

Many years ago Thomas Jefferson said, "Were we directed from Washington when to sow and when to reap, we should soon want bread."

In recent years Washington has shown an increasing as the pharmaceutical industry is concerned. We believe that the suggestions we have made here and the discussions of others are a positive beginning point. What is needed are (1) understanding of the importance of the negative consequences of continuing the status quo of regulation and (2) continuing direction to get the job done. We stand ready to assist in the process in any way possible.

# # #

(Note: In the interest of economy, the exhibits accompanying this statement were retained in the files of the committee where they may be researched upon request.)

Senator QUAYLE. Arriving right on schedule from Minnesota, Mr. Schuh.

Mr. SCHUH. Thank you, Mr. Chairman.

My name is G. Edward Schuh and I am professor and head, department of agricultural and applied economics, University of Minnesota.

My assignment today was to discuss the growth of productivity in U.S. agriculture, one of the important success stories in our economy.

My written testimony is divided into three parts:

One, a brief review of the data which document that sustained rate of productivity growth in U.S. agriculture over something like a 50-year period;

Two, a discussion of the sources of this productivity growth; and

Three, comments on some of the key issues that we face in the future.

As I understand it, you want me to just pick out some of the highlights at this point. So, let me do that.

Let me first talk about the record. There are quite a number of ways that one can talk about this and I think almost any one of them is dramatic. The one that I often like to cite is the fact that over a 50-year period, from about the mid-1920's to the mid-1970's, there was virtually no change in the total stock of resources used in agriculture. I am talking about the total stock of physical resources. You add up the land, the labor, the capital, the fertilizer and all of that, at the beginning of the period, the mid-1920's, and the end of the period, the mid-1970's—there was virtually no change in that.

Now, that is to say that all of that increase in output during that 50-year period—and it helps us to remember that during some periods that increase in output was more than markets could handle—all of that increase in output came from increases in productivity.

It was during this period when people changed their mind in thinking about agriculture. We have always traditionally thought about agriculture as a land and a resource base activity. We no longer do that. We think of it now as a science and technology-based activity.

Two other kinds of data that I think are rather dramatic indicators of the kind of productivity growth that we have had. We now feed our population plus export about $44 billion a year of agricultural products with something approximating 3 percent of our total labor force. No other country in the world comes close to that.

The second dramatic data is to recognize that the share of their budget that the consumer spends on food is something approximating 16 percent. Again, there is no other country in the world that has that low a share of their expenditures going for food only. That would not be possible if it were not for the very high productivity.

Now, the question then becomes: What is the source of that growth in productivity? And I think agriculture is probably relatively unique in the extent to which the new technology has come from a combination of the private sector and the public sector with a fairly heavy emphasis on the public sector.

There has also been within the public sector, I think, a rather unique partnership between the States in the form of the State universities and the Federal Government—the Agriculture Research Service, and Economic Research Service.

I think it might be useful to go back and trace just a little bit of the history of this because there were some rather remarkable pieces of legislation that came out of Congress that established this system.

There was the Morrill Act back in the 1860's, I guess, which established the land grant colleges with the emphasis on the teaching function in the agricultural sciences and the agricultural disciplines.

There was the Hatch Act in the beginning of this century that created the agricultural research system, which was very much of a partnership between the State and the Federal Government, but put the emphasis on having a very decentralized research system. And the decentralization came about by allocating Federal money to the States on a formula basis, but then requiring that that Federal money be matched by the States. The State experiment stations then were associated with the land grant colleges that had been created earlier and the first part of the partnership was established.

Later on, of course, the Federal Extension Service was established, which provides again a partnership arrangement between the Federal Government and the State government, and between the county governments as well. Those were also made part of the land grant college system.

So, one developed over time that tripartite arrangement, which combined teaching, research and adult education, to get the research out.

Now, it is not just a public sector system, however. The private sector has done a lot of agricultural research.

The data are not as good on that as one would like. The best estimates we have indicate that up to about 1965, something like 55 percent of the total investment in agricultural research was coming from the private sector. In recent years, it has been up to about 65 percent. So, the share that has been coming from the private sector has actually been increasing.

In my paper, I talk quite a bit about the fact that there has been a unique division of labor between the private and the public sector where, as one would hope, the public sector has done the kind of research that the private sector will not have the incentive to do, where there are not proprietary gains to be had. That ends up being in large part the investments, in variety improvement, in fertilizer use, the management practices, and that sort of thing.

I talk about some of the interesting cases.

Poultry research at one time was almost entirely in the public sector and over the years was transferred into the private sector because there were proprietary gains. Now some of that basic research for poultry now appears to be moving back into the public sector again.

There is a very interesting division of labor between the production of the inbred lines in the case of corn. The universities develop the inbred lines. The private sector takes the inbred lines, adapts it to local conditions, puts it in a state that it can sell, and, therefore, again has proprietary gains on it.

I could go on. I talk about quite a number of these kinds of things in the paper.

Let me turn to the last part that has to do with—Well, before I do that, what I would like to call your attention to is the fact that all of the attempts that have tried to evaluate the social rate of return to the public investments in agricultural research show a remarkably high rate of return. The lowest of those start at around 20 percent and the highest go up to over 100 percent.

I have those documented on page 11 of the testimony.

All this data indicates that the social rate of return to investment in the public research system has been extremely high.

When you contrast the rate of return on the private sector to the average rate of return on capital, it tends to be around 10 to 12 percent. You can see what a remarkable positive rate of return that that has been and what an important source of growth for the economy as a whole it has been.

Now, in the last part of my testimony I address the issues that we face for the future. Let me just go through those quickly.

I think the first issue is whether we will be able to sustain the public support for agricultural research in the future as we have had it in the past.

And I think to start that discussion the point that one has to recognize is that those very high rates of return indicate already that we have been underinvesting in this particular line of activity, and that one would get those rates of return down to comparable rates in the rest of the economy only by investing quite a bit more.

The question then is: Why do we underinvest to this extent?

I think there are a couple of reasons for that, the first reason being that there is somewhat of a paradox in the case of agricultural research in the sense that it has always been justified on the grounds that it was going to help the farmer. In fact, if you go back to the original Hatch Act and read the preamble to the legislation, it uses the quote that said "to have two blades of grass grow where one grew before," but in the context it was going to be the farmer that was going to benefit from that.

The truth of the matter is that it has not been the farmers that have received the benefits from the research. Most of the benefits of the research have been passed on to the consumer in the form of the lower food prices that I was talking about earlier.

Consumers are notoriously weak politically within the political system. And so, to the extent that they have been the main beneficiaries, that is probably one of the reasons why as a society we have tended to underinvest in that kind of activity.

Now, the other explanation that one has for it is that there are quite a number of spillovers from agricultural research. As you can imagine, the experiment station in Indiana is going to contribute benefits to the farmers in the State of Illinois and vice versa. The agriculture in those two States are sufficiently comparable for that to happen.

But States recognizing that will have a tendency then to "let George do it" for them. So they underinvest in research with the result that all of the States put together end up underinvesting.

I think one of the important points about this is that Federal support for agricultural research has been stagnant in real terms since about 1965 The State support has been growing over time. But I think the fact that the Federal support stagnated is not recognized, and does not take appropriate recognition of the fact that it is the consumers who benefit from agricultural research, and that there are significant spillover effects from one State to the other. The only way one would internalize those benefits would be for the Federal Government to make a larger commitment to the research side of it.

The second issue has to do with how to sustain the proper division of labor between the private and public sector. I think it is important to note that there has been a very effective complementary relationship that has evolved over the years between the private and public sector. The issue of whether research should be properly done in the private sector or the public sector is not a once and for all question, however, since the technology itself is continually changing and what was once properly an activity for the private sector may later become an activity for the public sector.

We really do not have very good mechanisms for sorting that out and making decisions about it. I think it is going to be one of the key issues that we face in the next decade simply because the research technology itself is changing so dramatically.

The third issue that I think will be very important is how to strengthen the support for basic research without losing the important articulation with the ultimate users of the research. Now, one of the things that I discuss quite a bit in my paper, as you know, is that what one has had in the land grant College System is a very strong mission orientation that has involved a very strong interaction between the farmers, producers, users, of this new production technology and the university system itself.

That interaction is fairly easy to obtain when the research system is producing applied research, technology that can be immediately adopted and picked up. The problem I think we face for the system as a whole is the fact that one runs dry on the applied side. So you end up with the land grant colleges themselves needing to do more basic research. And that is a much more difficult product to take out and sell to the farmers. It is very difficult for you to make them understand that what is going on back in that laboratory is some day going to have some benefit to them.

The fourth point I have made is how to sustain the efficiency and accountability in the system without stifling creativity and productivity. This is one that I could discuss for quite some time. But I would just like to make a couple of points.

One, the old system of allocating the research money by formula worked pretty well and the high rates of return that we have had to those investments I think is rather good evidence of that.

First, can be attracted to competitive grant systems. However, I think there are two consequences of having competitive grant systems or other systems of accountability. And the two problems that you have with it are:

First, you suck up a lot of the scientist's time in preparing proposals rather than for him to be in the laboratory doing the work that needs to be done.

Second, when one puts very strong accountability requirements on the researcher, it really is very stifling of creativity. He very soon starts to propose things that are easily accountable. And the things that are easily accountable are not likely to be the things that are going to have the large payoff over the longer term.

My main thrust here is to argue that we need to recognize the importance of creativity and to try to foster that creativity within the research system rather than put on a lot of regulations and accountability requirements that push it the other direction.

The final point that I make, which I will not discuss any further, is the question of sustaining the collaborative effort that we have had between the Federal system and the State system. There have been discussions about making a division of labor here where the basic research would be done in the Agricultural Research Service at the Federal level and the States would do the applied research. I really think that that is an unrealistic proposal because the distinction between those two is never quite that distinct in the first place. In the second place, I think it would establish a system of first class citizens and second class citizens in the research establishment. It could be quite counterproductive.

The comments that I make in my concluding comments have to do with the paradox of our current policy, giving a lot of emphasis to supply-side economics with the idea that we are going to increase productivity and increase capital formation. And yet, a lot of the budget expenditures for agricultural research and for other kinds of science and technology are being cut. Training programs are being cut. Educational programs are being cut.

I think the irony of this is that for some reason or another our productivity programs have been lumped together with welfare programs and all of them have been sliced.

I make the point that when we cut budgets for those items, we are truly striking at our human capital and we are doing it at our own risk. We need to recognize that when we look at our international competitors, like Germany, Japan, and the Soviet Union, none of them are making the same mistake.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Schuh follows:]

GROWTH IN AGRICULTURAL PRODUCTIVITY: WILL THE PAST SUCCESS CONTINUE?*

Mr. Chairman, my name is G. Edward Schuh. I am professor and head, Department of Agricultural and Applied Economics, University of Minnesota. My assignment today is to discuss the growth of productivity in U.S. agriculture - one of the important success stories of our economy. It is a pleasure for me to appear before this distinguished committee.

I would like to divide my comments into three parts: (1) a brief review of the data which document the sustained rate of productivity growth in U.S. agriculture for over fifty years; (2) a discussion of the sources of this productivity growth; and (3) comments on some of the key issues we face in the future. At the end I will have some concluding comments.

Past Trends in Productivity Growth in U.S. Agriculture

Before presenting some of the data on productivity growth in U.S. agriculture, it is useful to provide some historical perspective. Prior to this century, almost all of the increase in world agricultural production was obtained by bringing new land into production and by increasing the stock of resources used with that land. It was during this long period of our history that we came to think of agriculture as a natural resource-based industry, and in which we developed a certain land fundamentalism as we thought about agriculture.

---

*Testimony presented at the Hearings on Productivity before the Senate Subcommittee on Employment and Productivity, March 19, 1982.

In contrast, in the 50-year period between the mid-1920s and the mid-1970s, all of the increase in agricultural output in the United States was obtained with virtually no increase in the total stock of physical inputs - of land, labor, machinery and equipment, and other operating inputs. It is true that the proportion among these inputs changed dramatically over this period, with labor draining out of the sector, land staying approximately constant, and large inflows of capital substituting the labor that migrated to employment in the nonfarm sector. But the inflation-corrected value of the total stock of physical inputs was about the same in the mid-1970s as it was in the mid-1920s.

All of the large increase in agricultural production during this period and recall that at times this increase was such as to generate politically-troublesome surpluses - was due to growth in productivity. It was during this period that students of agricultural development stopped thinking about agriculture as a resource-based sector, and began to think of it as a science and technology based sector, or what we today refer to as a high-technology industry. This change in how we think about agriculture is the consequence of a remarkably efficient research and information system for agriculture and the payoff from investments that consistently have earned very high rate of return to society. But I will take that up in the next section. Let's first look at the data on productivity so that we have a better insight into what has been happening in agriculture.

The changes in the productivity of American agriculture can be viewed in three different ways. A very common way to view it is in terms of crop production per acre of cultivated land. A second way is in terms of labor productivity - the ratio of output per unit of labor input - which is a common index of productivity in the nonfarm sector. And finally, a third way is to consider an index of total productivity, which is calculated by dividing the index of farm output by the index of total farm inputs.

The first two of these measures are partial productivity measures. Although useful for some purposes, these indexes have the disadvantage that they may reflect nothing more than a shift in resource proportions, without there being a change in the underlying rate of growth in productivity. For example, an increase in the productivity of land may indicate only that more labor is being used per unit of land. Under these conditions, if one were to look at what is happening to labor productivity, he would find that it declined.

To measure underlying rates of productivity growth, especially as resulting from technical change, the best measure is the index of total productivity. If total productivity measures are constructed carefully, they can be interpreted as reasonably accurate measures of the contribution of technical change to the growth of agricultural production. A more cautious interpretation is that total productivity measures the growth in output that cannot be accounted for by the resources included in the index of total inputs.

The changes in all three measures of productivity are illustrated for U.S. agriculture for the period 1950 to 1978 in Figure 1, together with a comparison to changes in labor productivity for the nonfarm sector as a whole in the same period. During the 1950s and early 1960s, all three productivity measures for agriculture grew rapidly. During the late 1960s, the rate of growth of land productivity and total productivity slowed down. During the 1970s, these two productivity indexes appear to have renewed their upward trend.

It should be noted that the labor productivity index grew more rapidly than the total productivity index throughout the entire period. Recall that the agricultural labor force was declining throughout most of this period. Part of the growth in labor productivity is therefore due to higher capital investment per worker. In addition, it should be noted that the rate of growth in labor productivity in agriculture was significantly higher than the growth in labor productivity in the nonfarm sector in the same period.

More detailed data on changes in total productivity and in the two partial productivity growth rates for the period since the beginning of this century are presented in Table 1. The story these data tell are a rather interesting one. In the first place, there was no change in the average productivity of land in the first 25 years of the century, and an actual decline in total productivity. As a consequence of the latter, output increased at a slower rate than the total stock of inputs increased. Labor productivity grew at a modest rate, but that is because the labor input in agriculture was growing at a slower rate than other inputs in agriculture.

During the rest of the period, the productivity story is a reasonably consistent and dramatic story. Output grew at an increasing rate in each of the periods considered. As noted earlier, this increase in output was obtained with virtually no increase in conventional inputs. And an index of total factor productivity grew at a sustained and high rate.

The dramatic performance was on the side of labor productivity. But the productivity of land grew at a sustained rate also, but at a lower rate. The decline in productivity growth for land in the 1965-79 period is due in large part to the return of land to production that had been held out in previous periods. This land tended to be of marginal quality, and hence its return to production affected the aggregate productivity figures.

Labor productivity has been significantly affected by the large outmigration from the sector throughout the post-World War II period.

Table 1. Average Annual Rates of Change (Percentage per Year) in Total Output, Inputs, and Productivity in U.S. Agriculture, 1900-1979.

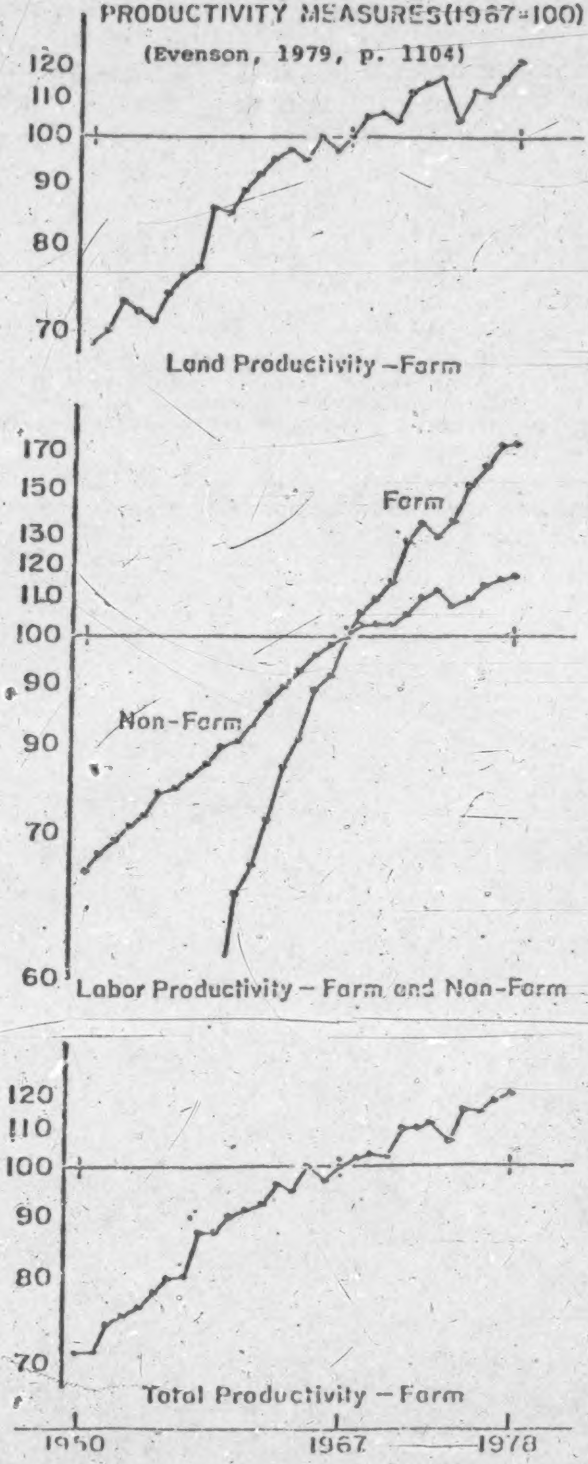
Item	1900-1925	1925-1950	1950-1965	1965-1979
Farm Output	0.9	1.6	1.7	2.1
Total Inputs	1.1	0.2	- 0.4	0.3
Total Productivity	- 0.2	1.3	2.2	1.8
Labor Inputs[a]	0.5	- 1.7	- 4.8	- 3.8
Labor Productivity	0.4	3.3	6.6	6.0
Land Inputs[b]	0.8	0.1	- 0.9	0.9
Land Productivity	0.0	1.4	2.6	1.2

Sources: Data from USDA, *Changes in Farm Production and Efficiency* (Washington, D.C.: 1979); and D.D. Durost and G.T. Barton, *Changing Sources of Farm Output* (Washington, D.C.: USDA Production Research Report No. 36). February 1960. Data are three-year averages centered on the year shown for 1925, 1950, and 1965.

a. Number of workers, 1870-1910; worker hour basis, 1910-1971.

b. Cropland used for crops, including crop failures and cultivated summer fallow.

Figure 1.



PRODUCTIVITY MEASURES(1967=100)[6]

(Evenson, 1979, p. 1104)

Land Productivity – Farm

Labor Productivity – Farm and Non-Farm

Total Productivity – Farm

In general terms, one can say that labor has been an increasingly scarce resource in agriculture over this period. The fact that it has become scarce relative to land has caused the factor-saving effect of technical change to be biased towards saving labor relative to saving land. How that came about is an interesting story in itself, but would take us rather far afield from our present interests.

The Source of This Productivity Growth

The data in Table 1 indicate an unusual performance for productivity growth in U.S. agriculture - a performance that is the envy of the world. From a policy standpoint, the question is "How was this unusual performance brought about?" The answer is by now rather well known: an unusually successful combination of public and private research and education programs, and a unique partnership between the state and federal governments in supporting agricultural research and extension.

The source of productivity growth, of course, is new knowledge in the form of new production technology. The production of new knowledge is an investment decision that society faces. It can invest more or less in the production of new knowledge [illegible] herefore produce a higher or slower rate of productivity growth.

In many parts of the economy investments in new knowledge are for the most part private decisions. The new knowledge can be imbedded in consumer or producer goods and the producer of the new knowledge can reap the benefits of this investment in the knowledge.

In the case of agriculture, that has not generally been the case. New plant varieties, for example, can be easily reproduced. Hence, a private firm would have little incentive to produce such an improved variety and the rate of technical change would be slow if we were dependent upon such sources.

Congress recognized this dilemma early on. It provided for public support for agricultural research, and it provided for it in an interesting way. The Hatch Act encouraged the creation of a decentralized agricultural research establishment by causing agricultural research stations to be created in every state in the union. Funds were provided for these stations in a unique formula basis, and individual states had to provide matching funds in order to receive the federal money. Over the years, of course, the state support of the system has grown more rapidly than the federal support and is now the preponderant source of support.

The Hatch Act was just one step in the creation of a unique public infra-structure for the production and diffusion of new knowledge for agriculture. The Morrill Act which preceeded the Hatch Act had established the Land Grant Colleges dedicated to the teaching of agriculture and other skills to the broad masses of society. Later legislation established an extension service to extend the new knowledge to farmers. This service also represented a partnership of federal, state, and local support. All three functions - teaching, research, and extension - were brought together in the Land Grant Colleges (now Universities). A Federal Agricultural Research Service was also created to round out the system, together with a parallel Economics Research Service.

A number of unique features characterize this research and teaching infrastructure. In the first place, there has from the beginning been a strong mission orientation to the system. Public servants were put to the service of the private sector. This gave them a strong problem-solving orientation, and provided almost from the beginning a strong articulation of the public research and teaching institutions with the private sector.

A second unique feature of the system is the competitive pressures that were built into it from the beginning. With strong state support, each director of the state research system wants the farmers of his state to be competitive with the farmers from other states. This competition forces a strong interaction with producer-user groups. It also forces relevance in the research endeavors, since the research had to be relevant if the researchers were to receive continued support from the state legislatures.

A third unique feature of the system was its association with the Land Grant Universities. This enabled the applied agricultural disciplines to remain closely associated with their mother disciplines. This association enabled the applied disciplines to benefit from advances in the more basic disciplines and thereby to renew themselves on a regular basis.

It is commonplace these days to argue that doing anything in the public sector is doomed to failure and one can expect only low productivity. The logical question to ask, then, is whether that has been the case with publicly supported agricultural research. The answer is a resounding "no"!

The results of previous empirical studies of the social rate of return to public investments in agricultural research (and in some cases extension) are tabulated in Table 2. What one finds from these studies is a persistently high rate of return to these investments - a rate that is substantially above the 10-12 percent rate of return to investments in the private sector. These high rates of return indicate that society is significantly under-investing in this line of activity. If it were investing at the proper level, this rate of return at the margin would be driven down to a level consistent with the rate of return on investments in the private sector.

Public sector research is not the whole story, of course. There has been a vigorous private research effort in the U.S. An important characteristic of the system is the extent to which the private and public sector research systems complement each other. Over the years a rather reasonable division of labor has evolved between the two sectors. For example, in the case of hybrid corn, the public sector (USDA and Land Grant Universities) has produced most of the inbred lines needed to produce the hybrids. The public sector has taken the inbred lines and developed locally adopted hybrid crosses. Similarly, over the years the bulk of poultry breeding work left the universities and went to the private sector. This freed up resources from the public sector to do more basic research such as physiology, molecular biology, and diseases and other pests.

The private agricultural research establishment is rather sizeable. My colleague, Vern Ruttan, estimates that in 1965 private sector R and D probably accounted for about 55 percent of total private and public sector research in support of the food sector.[1] By 1979 he believes the private sector share was probably in the neighborhood of 65 percent.

In concluding this section, a couple of points are worth making. First, the U.S. incentive system which motivates producers to rapidly adopt new production technology as it becomes available is an important factor influencing the high rates of return found in previous studies.

Second, the unique transportation and communication system the U.S. have evolved has also contributed to the high rate of return to investments in aricultural R and D. And finally, there has been a great deal of specialization in U.S. agriculture. Farmers have become increasingly specialized, as have regions.

---

[1] Ruttan, Vernon W., "The Private Sector in Agriculture Research" in Proceedings and Minutes, Twenty-Ninth Annual Meeting of the Agricultural Research Institute, Washington, D.C., October 1980.

Table 2. Estimates of the Return from Investment in Agricultural Research, U.S. by Commodity Group and Sector.

Investigator	Year	Commodity	Period	Annual Return (%)
Griliches	1958	Hybrid corn	1940-1955	35-40
Griliches	1958	Hybrid sorghum	1940-1957	20
Peterson	1967	Poultry	1915-1960	21-25
Schmitz & Seckler	1970	Tomato harvester	1958-1969	
		With no compensation to displaced workers		37-46
		Assuring compensation to displaced workers		16-28
Peterson & Fitzharris	1977	Aggregate	1937-1942	50
			1947-1952	51
			1957-1962	49
			1957-1962	34
Griliches	1964	Aggregate	1949-1959	35-40
Latimer	1964	Aggregate	1949-1959	N.S.
Peterson	1967	Poultry	1915-1960	21
Evenson	1968	Aggregate	1949-1959	47
Lu and Cline	1977	Aggregate	1938-1948	30
			1949-1959	28
			1959-1969	26
			1969-1972	24
Bredahl and Peterson	1976	Cash grain	1969	36
		Poultry	1969	37
		Dairy	1969	43
		Livestock	1969	47
Davis	1979	Aggregate	1949-1959	66-100
			1964-1974	37
Evenson	1979	Aggregate	1868-1926	65
		Technology Oriented	1927-1950	95
		Science Oriented	1927-1950	110
		Science Oriented	1948-1971	45
		Southern-Technology Oriented	1948-1971	130
		Northern-Technology Oriented	1948-1971	93
		Western-Technology Oriented	1948-1971	95
		Farm Management Research & Agri. Extension	1948-1971	110

Sources to Table 2

M. Bredahl, and W. Peterson, "The Productivity and Allocation of Research: U.S. Agricultural Experiment Stations," American Journal of Agricultural Economics, 58 (November 1976), pp. 684-92.

Philip L. Cline, "Sources of Productivity Change in United States Agriculture" (Ph.D. dissertation, Oklahoma State University, 1975).

Jeffrey S. Davis, "Stability of the Research Production Coefficient for U.S. Agriculture," (Ph.D. dissertation, University of Minnesota, 1979).

R. Evenson, "The Contribution of Agricultural Research and Extension to Agricultural Production" (Ph.D. dissertation, University of Chicago, 1968).

Z. Griliches, "Research Costs and Social Returns: Hybrid Corn and Related Innovations," Journal of Political Economy, 66 (1958), pp. 419-31.

Z. Griliches, "Research Expenditures, Education and the Aggregate Agricultural Production Function," American Economic Review, 54 (December 1964), pp. 961-74.

M. Knutson and Luther G. Tweeten, "Toward an Optimal Rate of Growth in Agricultural Production Research and Extension," American Journal of Agricultural Economics, 61 (February 1979), pp. 70-76.

R. Latimer, "Some Economic Aspects of Agricultural Research and Extension in in the U.S." (Ph.D. dissertation, Purdue University, 1964).

W.L. Peterson, "Return to Poultry Research in the United States," Journal of Farm Economics, 49 (August 1967), pp. 656-69.

W.L. Peterson and J.C. Fitzharris, "The Organization and Productivity of Federal State Research System in the United States," in Resource Allocation and Productivity in National and International Agricultural Research, Thomas M. Arndt, Dana G. Dalrymple, and Vernon W. Ruttan, eds. (Minneapolis: University of Minnesota Press, 1977) pp. 60-85.

A. Schmitz and D. Seckler, "Mechanized Agriculture and Social Welfare: The Case of the Tomato Harvester," American Journal of Agricultural Economics, 52 (November 1970), pp. 569-77.

It is important to note that none of these compete with the investments in R and D as sources of growth in productivity. They help explain why the social rate of return to investments in such activities has been high. But they have not biased the results.

Issues for the Future

As we look to the decade ahead the agricultural research system faces at least five major issues. Let's consider each one of these.

1. Can the public support for agricultural research be sustained in the future? One of the great paradoxes of the U.S. agricultural research system is that support for agricultural research has always been justified on the grounds that it would help the farmers, but in point of fact the main beneficiary has always been the U.S. consumer. Early adapters of new production technology obviously reap an economic rent from the new technology. But as more and more producers adopt the new technology, output increases, other things remaining the same, and commodity prices decline. This decline in commodity prices eventually diffuses the benefits of technology on a wide scale within society. But the ultimate beneficiaries are consumers, who are able to buy their food at a lower price.

   Over the last decade, agricultural exports have become an important source of foreign exchange. By making the demand for U.S. agricultural output somewhat more price elastic, this foreign demand permits a somewhat larger share of the benefits of technical change to be channeled to the producer. But a strong export performance, which a sustained rate of technical progress makes possible, causes the value of the dollar to remain strong in foreign exchange markets. A strong dollar enables us to import a given bundle of imports at a lower real cost in terms of domestic resources. Again, it is ultimately the consumer who benefits. Moreover, the benefits go much beyond the consumption of food.

The high social rates of return noted above indicates that even in the past, when farmers were politically important and the rationale for supporting agricultural research was to support this interest group, society was investing much less in agricultural research than was socially optimal. Now that the political power of the farmer is declining, one wonders what will sustain even the past level of investment in agricultural research.

When viewing the past, it is important to note that there are probably two reasons for the under-investment in agricultural research. The first is that the bulk of the benefits have gone to the consumers. Consumer groups are notoriously weak in political power. Moreover, at levels of per capita income that the U.S. now experiences, the share of income dedicated to food is so small (a consequence of the success of the research effort!) that consumers do not feel motivated at this time to defend their interests.

A second reason for the under-investment is that there are sizeable spillover effects associated with agricultural research. Technology produced in one state may be useable - within limits - in other states. State governments, perceiving this spillover of benefits to other states, are reluctant to make additional investments. The consequence of all states taking this perspective is a less than optimal investment overall.

The solution to both of these problems is for the Federal government to play a greater role in financing agricultural research. It is only at the Federal level that the spillover among states can be internalized, and that national interests such as a rise in the value of the dollar can be reflected.

Unfortunately, Federal support for agricultural research has stagnated since about 1965. Present proclivities of the Office of

Management and Budget are to further reduce Federal support. That obviously would be a mistake. A smaller role of the Federal government in agricultural research will almost certainly lead to a greater under-investment in this important activity. To fail to make investments with such demonstrably high rates of return is to sacrifice important sources of growth in GNP for the nation.

2. How to sustain the proper division of labor between the private and public sector in agricultural R & D? A very effective complementary relationship has evolved over the years between the private and public sector. The publicly supported universities and the USDA have done research and development activities that was not in the interest of the private sector to do. The private sector, for its part, has done that research for which it can collect a proprietary gain. Hence, the bulk of the research on mechanization has been done by the private sector. The bulk of the genetics work has been done in public institutions. Poultry breeding, on the other hand has been picked up by the private sector.

   The issue of whether research should properly be done in the private or public sector is not a once-for-all decision, however, since the technology itself is ever changing. What once was properly a private sector activity may eventually need to be done in the public sector. The question of how to handle these reallocations becomes an important issue, especially when the public support for research is declining.

   We need to recognize that the rate of return to private investment in agricultural research can be strongly influenced by public investments. This brings out the complementarity between the two kinds of activities, and emphasizes the importance of sustaining both kinds of ventures.

3. How to stengthen the support for basic research without losing the important articulation with the ultimate users of the research? The land

grant colleges with their strong mission orientation in research and adult education has sustained a strong dialectic interaction among researchers and research administrators, policy makers, and farmers and other users of agricultural research. This interaction is easily maintained when the research is strongly applied in character. It is more difficult when the research is more basic.

We may be moving to a situation in which more and more of the applied research will be picked up by the private sector, leaving the universities to concentrate more on basic research. Just the evolution of science and technology in general should press for more basic research in the universities as existing stocks of basic knowledge are exploited. These trends break down the articulation between the user groups and the universities. Sustaining public support for the research program will be increasingly difficult under these conditions.

In a somewhat different dimension some observers have argued that Federal support for agricultural research should be channeled to basic research and the states left to pick up the applied research. Such a division of support fails to recognize that spillover effects even from applied research is quite sizeable. It also fails to recognize that sustaining support for basic research even at the national level is not easy. Unless we find an institutional mechanism for dealing with this problem we may find it increasingly difficult to provide the support for basic research that we need.

4. How to sustain efficiency and accountability in the system without stifling creativity and productivity? At one time the bulk of Federal support for agricultural research was allocated to the states by formula funding. This gave experiment station directors and individual researchers a great deal of discretion in how they used these resources.

Over time, however, that has been an increasing concern for accountability within the system, and a desire to generate more competitive pressures - presumably on the expectation that this would lead to improvements in the overall efficiency with which the resources are used. Although well-intentioned, these developments may not have had the affect desired. In the first place, an overriding concern with accountability can have a very stifling affect on creativity. Researchers eventually reach the point where they propose to do what they can easily justify, rather than potentially important "blue-sky" research that would have a greater payoff in the long run.

Similarly, the demands for accountability have imposed greater and greater managerial responsibilities on the research process. The consequence is to have people making decisions about research who don't know what they are talking about. Not only can that lead to misallocation of resources, it too stifles creativity - that very essential ingredient of any research process.

Both the concern for accountability and the shift to competitive grants have had an additional pernicious effect in that they have absorbed the scarce times of capable researchers in senseless report writing and in the preparation of grant proposals. Scientists have unique talents. We should not burden them with make-work activities in some misguided effort to make them either more accountable or more competitive.

5. How to maintain the productive team-work between the Department of Agriculture and the Land Grant Universities? The relationship between these two groups has never been easy. But a workable partnership has been worked out that overall has been a productive one.

This partnership in experiencing a number of challenges at the present time. The proposal mentioned earlier to have a Federal emphasis on basic research and an applied emphasis at the state level would surely undermine the relationship. Similarly, attempts to set national priority goals and to manage the research process from Washington would also be counter productive.

There is an old adage that we might profitably keep in mind on some of these issues. The demonstrably high rates of return to public investments in agricultural research and extension suggest that, except for not making sufficiently large investments, we have been doing something right. Hence, we should heed the old adage "If it ain't broke - don't fix it!" We should sustain our Federal-State partnership rather than to fix it.

Concluding Comments

The new rhetoric of supply-side economics, despite its good intentions, is now posing a real threat to some of the most important supply-side activities in our economy. Surely investments in research and development, in science, and in technology, and in the education and schooling of our labor force are some of the most important activities we do to raise the productivity of other resources in our society and to maintain our competitive edge in the international economy. Yet, these important investments are lumped together with welfare programs - for some perverse reason - and are suffering budget cuts, when if one were to believe the rhetoric, we should actually be strengthening these activities.

We destroy our human capital at our own risk. And the cuts to science and technology budgets, together with those for education and training, strike truly at our human capital. We need to recognize that our international competitors - Japan, Germany, and the Soviet Union - are not making the same mistake.

Senator **Quayle**. Thank you very much.

I thank all the distinguished panel members for their very detailed and outstanding testimony. All of you offer some long-term solutions to the problem of productivity, whether it deals with the regulation or the cooperative attitude in the public and private sectors.

I do just have one quick question. I am running a little bit behind time myself. But the staff will be working with you because your testimony is so good.

Mr. Dallob and Mr. Schuh commented on one factor of the research and development. And I believe Mr. Dallob talked about going back to a 3 percent of GNP where it was in the 1960's.

I wonder if you could just very quickly sort of say what places are we cutting and where should we perhaps be paying more attention?

Mr. Schuh mentioned education and training.

This is of a short-term interest to me because we are now debating the budget for the Senate and the entire Congress.

I wonder if you have any specific recommendations along these lines; where we ought to be proceeding or where, in fact, we are cutting that is going to hurt productivity.

Mr. **Dallob**. Well, Sperry is a conglomerate, but our major division is in the computer business. And despite that the country is in a recession, we find a shortage of skilled people. We have lots of openings for engineers, programers, and there has been forecasts of about a 40,000-man shortage of people for our industry by 1985.

I think that, as a personal opinion, anything that would strike at the education of scientists, engineers, programers, would endanger our opportunity to go on as we have as a very fruitful productive industry.

Senator **Quayle**. Do you feel this is happening?

Is this happening with the budget right now?

Mr. **Dallob**. Well, again this is kind of an uninformed opinion.

Senator **Quayle**. What is your impression?

Mr. **Dallob**. My impression is that, yes, loans for graduate students, for example, in all types of fields are being cut back, which may diminish the number of students going on to graduate studies. And I would view that with some alarm. We need those kind of people in larger numbers.

I attended an MIT seminar earlier this spring where the fact was made that Japan is graduating 40,000 engineers this year. We are graduating as a country 28,000. They have half our population.

When you talk about innovation and productivity, you have to have the people. It is key. They are the key both for the capital equipment and for the research and development. If you do not have a trained work force, it is very hard to see how we are going to progress at the rates we have progressed at.

Senator **Quayle**. Are the other panel members' impressions the same as Mr. Dallob?

Mr. **Merchant**. Yes.

I would just like to point out and reemphasize what Mr. Dallob said. Certainly the latest budget thrust has been to cut back on science and engineering education support by the Federal Government. That is certainly very detrimental to R. & D. in support of civilian industry capability.

Mr. DAVIS. Mr. Chairman, I am not an expert, but I do have an impression from reading that there may be that cutback occurring and concern about shortfall.

I do want to express a personal opinion though that may be at some odds with other comments. And that is that I believe that the industries involved in the ultimate employment of these special graduate students and trained people have a responsibility through volunteerism, through their own corporate contributions and support of colleges and universities, to at least make a substantial attempt to redirect their corporate resources as a sort of long term investment for their own best interest in the universities themselves. And while I would not pretend to know the proper balance between public versus private funding of graduate student and undergraduate student loans, I would encourage the private sector leadership, not only in their corporate roles, but in their community roles, to try to find private financing alternatives to public funding cutbacks.

Senator QUAYLE. Mr. Schuh.

Mr. SCHUH. The University of Minnesota has had its budget cut $28 million in the current biennium. This has imposed cuts across the board in the university, although they have not been taken across the board.

But in the case of the agricultural part of it, the teaching program has been cut; the research program has been cut; the extension program has been cut. The extension program has been cut by almost $2 million.

In my own department, I have four open positions that I am not able to fill. And the horticulture department has three open positions that it cannot fill and will not be permitted to fill. The entomology department has four positions to be filled. Then there is a scattering of one or two positions around.

Now, when one disrupts biological research programs that could have an extensive period of life, one does not come back and pick those up right away.

The data are available on what has been happening to Federal support of agricultural research. That has been cut. It is being held, I guess, this year constant in nominal terms, which implies a reduction in real terms.

The budget of the National Science Foundation has been cut.

I mean one could just go down a long list.

Plus the education loan programs that enable students to go to work.

Again I would come back on the agricultural side and say every analysis that has been made of the market for those students does not indicate that there is any kind of saturation or any excess of students. To the contrary, there is quite a shortage of students.

Senator QUAYLE. Again I thank the distinguished panel.

Mr. Davis and Mr. Virts, I have enjoyed working with you in the past. I am particularly interested in your comments about regulation.

Mr. Merchant, thank you for your very futuristic approach to things.

Mr. Dallob, you are the growth industry. You are the one who is going to be expanding. I certainly appreciate your sensitivity to this R. & D. problem. It is one that has come up before.

I believe, as Mr. Schuh has pointed out, that we need this partnership. But also, as Mr. Davis points out, we also need to take a little bit more on ourselves.

I cannot help but reflect on what is happening in Fort Wayne, Ind., with the floods right now. It is not the Government in there doing it, although the Army Corps of Engineers is helping somewhat. It is really coming from those kids out of the high schools, and the neighborhood, and the people that are willing to do it themselves. And that kind of spirit really needs to be regenerated.

As we have this cooperation, I think productivity has a lot to do with feel.

The panel before you talked about this labor-management issue and got into the disparity. But when you get beyond the statistics and everything, it really comes down to human nature and what kind of psychology, what kind of an attitude, we are going to have.

But your testimonies are very, very detailed. And, believe me, we really appreciate them because that is what we are trying to do; to compile as many resources as we possibly can.

Again thank you very much for your kind attention and your participation.

Thank you very much.

[Whereupon, the subcommittee was adjourned at 12 noon.]

PRODUCTIVITY IN THE AMERICAN ECONOMY, 1982

FRIDAY, MARCH 26, 1982

U.S. SENATE,
SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY
OF THE COMMITTEE ON LABOR AND HUMAN RESOURCES,
Washington, D.C.

The subcommittee convened, pursuant to notice, at 9:45 a.m., in room 4232, Dirksen Senate Office Building, Senator Dan Quayle (chairman of the subcommittee) presiding.

Present: Senator Quayle.

OPENING STATEMENT OF SENATOR QUAYLE

Senator QUAYLE. The subcommittee will come to order.

Today, we will conduct the second in a series of hearings on productivity in the American economy. This morning, we will turn our attention to the impact of new technologies on labor productivity and its implication on future training and education needs.

We have already heard from a panel of experts on the difficulties facing industries with low productivity growth. Last week, this subcommittee heard testimony describing dramatic advances in manufacturing production. For example, an entire factory producing parts for robots and machine tools, which operates unmanned for 24 hours at a time, with 75 to 80 percent utilization, is now operating in Japan. We explored the current state of the steel industry, both worldwide and in the United States, and the ways in which increased productivity might improve this industry. Our witnesses highlighted the need for a strong approach to manufacturing-related engineering education and research in our colleges and universities. The subcommittee has been urged to seek better incentives for cooperation between labor and industry in implementing the new technologies.

From every panelist came the call: Increased incentives from Government for improving labor productivity.

This morning, we turn our attention to the new technologies and how they will affect the labor market. I hope that we can have a lively and spirited discussion on the implications which these new methods will have for future employment and training needs. What are the current trends in technology for manufacturing, biology, and energy? Which technologies are likely to most affect the labor market? What will the impact be on education and training for the coming decade?

The need for a full discussion on these issues is clear. As a nation, we must produce about 15 million new jobs in the 1980's. Although unemployment today stands at 8.8 percent, the demand for certain skills such as computer design, operation, and programming, are at an all-time high. As our panelists today will show, imbalances between the demand for and supply of highly trained personnel may grow over the coming decades. This is a welcome relief. Many explanations have been advanced for this imbalance: Rapid shifts in development and applied technologies; changing demands for certain products; and changing national priorities. Studies show us that while the labor supply is highly adaptable, pockets of inflexibility may persist well into the 1990's. The possibility that structural shifts in the labor force such as workers' average ages may result in reduced labor adaptability is very real.

I hope that we will have time for a wide discussion of the issues this morning. I would remind each of our panelists that their entire written testimony as submitted will be entered into the record, and if they want to read that testimony or summarize it, then we will get into the questions and answers.

Our first panel is Mr. George Ansell, from the Rensselaer Polytechnic Institute; Jae Edmonds, from the Institute for Energy Analysis; and from the Genex Corp., David A. Jackson.

STATEMENT OF GEORGE S. ANSELL, DEAN, SCHOOL OF ENGINEERING, RENSSELAER POLYTECHNIC INSTITUTE, TROY, N.Y.; JAE EDMONDS, SENIOR ECONOMIST, INSTITUTE FOR ENERGY ANALYSIS, WASHINGTON, D.C.; AND DAVID A. JACKSON, VICE PRESIDENT AND CHIEF SCIENTIFIC OFFICER, GENEX CORP., GAITHERSBURG, MD.

Mr. Ansell. Thank you, Senator Quayle.

I appreciate the invitation to speak to the committee, and will speak informally, as my written remarks are available to both you and the committee, and to the public who is in attendance.

What I would like to address in a short, informal overview, is the nature of the new technologies and how they may impact both productivity and labor force. I would then like to speak to some issues which affect the rate of implementation of these technologies in American factories.

I have distributed an outline of my presentation so that it will be easier to follow.

The history of high technology in the United States is an interesting one. Worldwide, machines have been used for the last two centuries to replace physical labor and specialized skills; they have been assists to people rather than replacements. In recent years, the emphasis in technology and manufacturing has been on automation, fixed automation, and hard tooling. That is the kind of automation which does one-of-a-kind production—made automobile engines in the 1950's; tin cans; light bulbs; containers—automation which has no flexibility or adaptability to produce other goods and uses lower labor content and has made rapid productivity gains.

The manufacturing technologies in our country and abroad, until recently, have required partnerships with labor—assembly lines, assembly tools, and skills. New manufacturing technologies auger a change in that relationship; no longer a partnership between people and machines, but the use of machines with the ability to be taught and learn and then operate with very low worker assistance or intervention. These are called intelligent machines. They are machines which have a partnership between a machine tool and a computer, in which human intervention is in the original design and the programing for that computer. These are flexible machines which allow automation that no longer has only a single output or single use. That flexibility is the key point. These are machine tools which have the adaptability of a labor force, that kind of equivalence. What do we mean by an intelligent or smart machine? It is a machine in partnership with a computer. It can take information, store it, and then is able to perform decision processes, as it gets input information. The type of input information we are talking about is obtained from equipment called sensors. For machines, these are equivalent of sight, smell, and hearing. Sensors obtain information from the ongoing process on the manufacturing floor. As a result, the machine knows when its tools need to be replaced, or it knows when there is a bottleneck on the production floor, or it knows how much of which machine's time is being used for what job and process, so that it can automatically schedule and move things about the floor.

It is the combination of the computer, the machine, and the sensor, together with programs that are written by people that give these machines what is called artificial intelligence, or the ability to make decisions. So we have machines that have a decision-capability; they can be taught to respond in more than routine ways to an operation. This is the machine tool, the smart machine, or the intelligent machine technology which is affecting manufacturing worldwide.

One type of intelligent machine is the robot. This is an intelligent machine which has captured people's imaginations because in some ways it is like a person. It is a manipulator; it mimics a person's arm. It does the things that a person could do if a person were standing in place instead of a robot. The only difference is that the robot arm is faster, it is more reliable, it is more precise, it is stronger, and it has longer reach. It does not take breaks, it does not need to go to the bathroom, and it can work 24 hours a day. And it rarely makes mistakes.

This is a smart machine, if the robot can be trained not only to do something repetitively, but also to be able to gather information from the manufacturing process and respond to it. For example, when something comes by that is not of high quality, it can reject it automatically; or it can be used to automatically change tooling in a machine as the production process is changed. So the robot is one type of intelligent machine which is easy for us to relate to and understand, but it is only one type. There are other intelligent machines that perform different types of functions.

One of the issues that we have to be prepared to address is that until now, most types of manufacturing have required people. We have designed factories to have people as part of them. When we have factories without people, we will not have to design that way anymore.

As an aside, it is interesting to note that we are now seeing factories where robots work at work tables whose tops are 30 inches off the floor so that if the robot breaks down, a person can readily take its place. That is a very interesting view of the replacement of machines by people, and vice versa. Unfortunately, the person is not a very good replacement for the machine.

At the present time, there are approximately 100,000 robots installed throughout the world. Two-thirds of these are in Japan. Of the intelligent kind, there are something fewer, but two-thirds of the programable or intelligent ones are installed in Japan. Most of the industrialized countries of Western Europe, some of Eastern Europe, and the United States also have a significant, but not as large a robot population.

Now, what do we foresee for this type of machine technology and how it will change in the future? We are seeing only the beginning now. On one hand, we are seeing an evolutionary change. These machines will get smarter; the sensors will be able to distinguish things more readily, to see objects in three dimensions. The arms of the machines will be faster, more precise, and easier to teach. They will communicate with people in a simpler way. But more importantly, we are beginning to learn how to integrate these machines in arrays where machines work together and communicate, and where a robot can service four or five other smart machines with different tools and can move work pieces between them. So we are seeing the development of what are called manufacturing cells. These are arrays of smart machines of different types in which the intelligence or computer systems in the cells schedules, handles, changes tools, moves products in those cells, thereby forming what is referred to as the factory of the future. These are manless, low-labor content factories, where not only do we have arrays of machines and machine tools that can interact and interface with each other, but also have the intelligence and the decisionmaking capability to start performing white-collar skills. Until now, most people, when describing intelligent machines, speak about the interchange or replacement of the skills of the blue collar work force and intelligent machines. In these manless factories of the future, we are talking about the interchange or replacement of the white-collar force and the intelligence and assistance of machines to do production scheduling, quality control, process control, inventory, and billing—procedures and functions which can be totally integrated within the same system of communication and information processing that is being developed in these intelligent or smart machine tools.

And as an aside, Senator Quayle, the impact of intelligent machine technology on the factory floor is trivial compared to the impact this same technology will have when it is applied to the functions of the white-collar work force in the service industries. It is the same set of worker skills that can be replaced by intelligent systems, and moreover the transfer of the technology to the white-collar service industries is an easier base than is the transfer to the blue collar manufacturing work force.

The disincentives and problems that impair the transfer and adoption of this technology is less in the white-collar sector in the service industries than it is in the manufacturing industry, and perhaps the committee is focusing on the wrong sector of the labor force.

Going back to the topic of the manless factories of the future, we find that for the first time we are beginning to disconnect labor from production output; we see factories where a few people have an output which is only based only upon investment capital—not labor content, and where there is no longer a relationship between labor and output. This will become the general manufacturing trend of the future.

As a result, the location of plants becomes divorced from labor also, and therefore plant locations becomes unimportant in terms of what either the skills of the market are locally or what the local market rate for labor is.

In terms of the adaptation of these modern innovations of machine technology, we have a problem. The innovation for smart machines and tooling both for hardware and the computer systems are a U.S. innovation and discovery. Almost all of the worldwide development in this technology has been based upon U.S. innovation and discovery. The question is: Why do we excel at innovation and discovery and at the same time, lag in the implementation of these technologies? I believe the underlying issues are clear. In the United States for the past 30 years, we have had the social structure, the partnerships between the Government, industry, and universities—to foster and develop creativity and innovation in both science and engineering. We have had no equivalent structure to do this for the implementation of new technologies in either the manufacturing or the service industries. Both Japan and the industrialized countries of Western Europe have had such structure in place.

Additionally, it is important to have within the manufacturing industries the ability to realize the benefit of productivity improvement from the adoption of new technology. One key issue here has been the difficulty in the translation of discovery and innovation, which increases labor productivity and at the same time will displace labor. In an industry in which growth in product demand can absorb increased productivity, it is easy to accept growth in productivity. That has been the case for new emerging industries and for most overseas industries. It has not been the case for most mature industries in the United States. As a result it has been very difficult to adapt modern manufacturing technology in our mature industry.

As an example of this problem, one of the leaders in the development of intelligent machines and robotics has been the U.S. automobile industry. The moves to adopt this technology started in that industry in the late sixties. They stopped soon after.

Another problem in adopting new manufacturing technology arises from the investment incentives affecting placement of this equipment within factories and in companies. We usually talk about this issue solely in terms of cost and tax incentive, but, additionally, there is a tremendous personal and social risk in placing new technology in an industry if the people within that industry, both management and labor, have no experience with that technology. Most overseas countries who are fostering their growth in new manufacturing technologies have devised methodologies for reducing the risk for adopting new technology. These provide painless initial experience through the use of demonstration programs. The United States has used similar methodology in both the defense and the aerospace industry very effectively. Until recently, NASA sponsored model demonstration and technology programs within our aerospace and aeronautics corporations. It has recently withdrawn from that activity. There is no equivalent activity in the general manufacturing industry. The Japanese Government particularly has used MITI as a means and a structure to provide initial experience within Japanese industry so they can take a riskless move into the adoption of new technology.

I submit to you that if we do not address these issues, we have problems. No corporation will survive unless it is competitive. It can change its productivity in two short-term ways. It can adopt new technology and displace labor. Or, it can increase its productivity simply by lowering its labor rate by going offshore. Both of those moves have the same equivalent effect on our labor force. They reduce it. But the move offshore also takes our means of production out of this country. I think we must now start addressing ways in which we can structurally affect the adaptation of new manufacturing and high technology systems in American factories in ways that are beneficial to both industry and labor.

I will try to review very quickly the trends in manufacturing technology, problems in the implementation, and the impact on the labor force. I realize it is an extremely complex issue. It is an issue which in the long haul will probably force a change in the social contract in this country. But I believe initially we should first establish a national program to reduce the risks of technology implementation. We should be beginning to address the dislocation of the manufacturing labor force, which is sure to increase, and increase radically as time goes on. We have not had a reduction in the manufacturing labor force in the United States for the last 30 years. We have had slow growth, resulting in essentially a stable manufacturing labor force between of 16 and 20 million people. In the next 20 years, this figure will probably drop as an absolute number, to about one-half. While we will not need a large number of manufacturing people, we are going to need an unusually skilled group of engineers and technologists who have the qualities and abilities to design, implement, and maintain these types of factories if we want to maintain our competitive productivity.

Thank you very much.

[The prepared statement and additional material suplied by Mr. Ansell follow:]

TESTIMONY OF GEORGE S. ANSELL, DEAN, SCHOOL OF ENGINEERING, RENSSELAER POLYTECHNIC INSTITUTE, TROY, N.Y.

INTRODUCTION:

Senator Quayle, I am honored to have this opportunity to testify before the Senate Subcommittee on Employment and Productivity. Let me begin by saying that I share your view that "declining productivity is one of the Nation's most serious economic problems." Let me also venture to say that the problem can be solved, but that the equation is very complex. And the solution, when found, has the potential of impacting not only the economy, but our entire socio-cultural system.

Part of the solution is to improve manufacturing technologies by applying computer and information systems to manufacturing processes. We have only just begun to do it. BUSINESS WEEK has dubbed this current trend the start of the "new industrial age." It means robots, intelligent machines, flexible automation systems, the factory of the future. You have all heard the terms.

These new manufacturing technologies are the subject of my testimony today. To this subject I bring my perspective as engineering dean of the oldest technological university in the country.

It is my intent to discuss with you some of the issues that surround the new manufacturing technologies including their potential impact on productivity, on employment, and the factors affecting the commercialization (implementation) of these technologies on the American manufacturing floor.

THE CONTEXT:

To place in perspective the development of "intelligent machines" and their impact on manufacturing, it might be valuable to consider this development in an historical context.

The enormous gains in 19th century manufacturing productivity were led by the development, and harnessing, of sources of power: water, steam, internal combustion, and electricity. Manufacturing output became more decoupled from man's physical labor.

Interchangeability of parts, assembly operations, and the development of machine-tools, allowed skilled machinists to rapidly produce goods that duplicated the laborious output of the artisan. Productivity became dependent on the partnership between the machine-tool and the skilled machinist.

Mass production and the increased gains in 20th century productivity have been paced by the refinement of this process: developing specialized, and now automated, machine-tools that require fewer skills to operate. Examples are the application of "hard tooling" (such as transfer lines for machining automobile engine blocks in the 1950's and '60's) and the development of fixed automation. Fixed automation consists of machinery especially designed to make one product, through a fixed set of operations, with no flexibility.

Such advances in machine-tool technology and fixed automation have been particularly well-suited for large volume production and simple assembly operations. Small volume and more complex assembly operations have still remained largely dependent on worker skill and control.

The remaining tasks require less skill, are often the most dehumanizing, and paradoxically, the most difficult to replace by technology.

THE NEW MANUFACTURING TECHNOLOGIES:

It is the development of flexible automation, suitable not only for large volume production, but also for small volume production and more complex assembly operations that is currently being addressed by the development of "intelligent" machine technology--the combination of machine and computer. These are "intelligent" machines in the sense that they are versatile in function, can be "taught" new operations and sequences, and can repetitively perform those operations without additional human input.

THE ROBOT:

The robot is a good example of an "intelligent" machine that has of late particularly captured the public's interest and imagination. This machine can be programmed to mimic the movement of a man's arm--except that the movement is more precise and rapid, is stronger, and has the ability to extend its reach. It is a manipulator that can hold and operate tools, move objects, operate a paint sprayer, or weld car bodies. It "learns" easily, doesn't forget, makes virtually no mistakes, can work three shifts per day, and readily replaces a worker's arm (and thus the worker) while performing a repetitive function, e.g., loading a machine or assembling parts into a finished product. This very flexible, reliable machine was the first wave of the new manufacturing technology.

In 1981, the Robot Institute of America reported (1) 96,639 industrial robots in place worldwide, approximately two-thirds of which are in Japan (Table 1). The uses to which they are put are shown in Table 2. This same survey projects for 1985 that new robot installations will number 16,000 for Japan; 7,700 for the U.S.; 5,000 for West Germany; and 3,000 for Great Britain. By 1990, the annual installation rate is forecasted to be 31,000 for the U.S.; 29,000 for Japan; 21,500 for Great Britain; and 12,000 for West Germany.

In addition to the obvious impact of robots on productivity by virtue of increased speed and reliability--there are other benefits. Using robots to spray paint, for instance, removes the worker from a hazardous environment, and paint consumption is reduced because robots are most efficient painters.

TABLE 1

1. Total robot population, by country for five types of equipment

Country	Type A	Type B	Type C	Type D	Subtotal	Type E	Total
Japan		6,899		7,347	14,246	53,189	67,435
FRG	290	830	200	100	1,420	10,000	11,420
USA	400	2,000	1,500	200	4,100	NA	4,100
Switzerland	10	40			50	8,000	8,050
USSR							3,000
Sweden	250	150	250	50	700	100	800
Czechoslovakia	150	50	100	30	330	200	530
Italy		data not received by press time					
Great Britain							371
France		data not received by press time					
Poland	60	115	15	50	240	120	360
Denmark	11	25	30		66	110	176
Finland	35	16	43	22	116	51	167
Belgium	22	20			42	82	124
Netherlands	48	3			51	30	81
Yugoslavia	2	3	5		10	15	25
Total							96,639

A = Programmable, servo-controlled, continuous-path
B = Programmable, servo-controlled, point-to-point
C = Programmable, non-servo robots for general purpose
D = Programmable, non-servo robots for diecasting and molding machines
E = Mechanical transfer devices (pick-and-place)
NA = Not available
Source: RIA, based on preliminary survey responses

TABLE 2

2. Applications

Country	Welding	Painting & finish	Assembly	Machine loading	Foundry	Other
Japan	4,500	481	9,602	14,003	2,300	
FRG	600	170	55	250	5	
USA	1,500	540	40	850	840	400
Switzerland	5	5	10	25	5	
USSR		estimated breakdown unavailable				
Sweden	200	130		450	15	85
Czechoslovakia		estimated breakdown unavailable				
Italy		data not received by press time				
Great Britain	107	69	5	147		43
France		data not received by press time				
Poland	40	10	150	160		
Denmark	5	11	8	130	20	
Finland	11	16	4	61	15	58
Belgium	18	8	2	14		
Netherlands	20	20		10		
Yugoslavia		2		1	7	

Source: RIA, based on preliminary survey responses

BEST COPY AVAILABLE

Further, energy is conserved because it is no longer necessary to heat the spray booths.(2)

These highly effective robots reflect the practical application of a 60-year-old concept and 20 years of research and innovation.(3)

SMART MACHINES:

With the extension of more sophisticated sensor capability (touch, feel, measure, see), sufficient on-line (from the on-going process) information can be provided to interact with stored computer programs to permit some decision-making or choice, thereby using rudimentary artificial intelligence to create the second generation of "smart"-machine technology.

In the near term, through the '80's, "smart"-machine technology will advance along two main fronts:

1. Evolutionary efforts will be made to improve their functioning as stand-alone units--strengthening their "intelligence" and versatility while improving precision, speed, load capacity, and maintainability.
2. Efforts will be made to combine and integrate "smart" machines into a functioning versatile machine-tool unit under computer control. An array of machines and robots in a manufacturing setting will form the basis of flexible manufacturing cells that can schedule and transfer work pieces as well as select and transfer tools during the course of performing manufacturing and/or assembly functions.

Such manufacturing cells have already been put in place by Fujitsu Fanuc in Japan to assemble D.C. motors, and by Electrolux in Sweden for the production of refrigerator condensors.(4)

It is in the development of the manufacturing cell that the full impact of "intelligent"-machine technology becomes clear. The almost simultaneous application of computer and information systems to all aspects of the manufacturing process, from initial product design through final assembly, allows the formation of an array of "intelligent" machines as a total integrated functioning unit under computer control. The manufacturing cell thus becomes the first step toward the factory of the future--a completely automated flexible manufacturing system, without people and paper. Even the operations, management, and production decision-processes become automated. Production control will become independent of man's direct intelligence. Moving toward that goal, several "manless"* plants have been set up in Japan. The most advanced of these is the Yamazake Machine Works in Nagoya.(5)

THE NEW MANUFACTURY TECHNOLOGY AND EMPLOYMENT:

Of major significance is the impact intelligent machines and the factory of the future will have on the work force in manufacturing.

Although technical changed have always displaced some workers and demanded different (and usually lower) skills, until now, the factories still required a labor force. While not all productivity gains have been absorbed by increased product demand, the U.S. labor force in manufacturing has remained essentially stable for the past thirty years at between 16,000,000 to 21,000,000. Manufacturing labor has become a smaller percentage of the total work force, dropping from 33% to 22% over this period.(6)

Intelligent machines and the factory of the future will sharply change the character and scale of the manufacturing work force. There will be a demand for far fewer, but very highly skilled workers: those who will be able to design and build these complex manufacturing systems, and those who will be able to maintain them.

---

*very low labor force

Also consider the fact that the location of this labor-free factory of the future becomes less dependent on labor force and focuses more on the availability of raw materials, market, transportation costs, tax, and other material incentives.

We as a Nation should be prepared to address, before the fact, to the extent possible, the dislocations that will surely follow widespread adoption of "intelligent" technology. It is obvious that the unskilled and low-skill labor demand of manufacturing will diminish sharply. Of equal consequence will be the reductions in the "white collar" manufacturing labor force as intelligent systems replace the scheduling, quality control, and other production management functions.

THE NEW MANUFACTURING TECHNOLOGY AND COMMERCIALIZATION

Modern manufacturing technology--robotics, intelligent machines, and manufacturing cells--is based almost entirely upon U.S. research and innovation. However, it was brought to commercial success by foreign engineering and management skill. Why?

Robots were a U.S. 1960's innovation and a Japanese 1980's commercial success. Why?

In 1969, one of the "big 3" U.S. automakers, the leader in the automotive application of robot technology, installed 28 welding robots on its then-new Lordstown, Ohio production line. With the exception of one other automaker's installation of robots in 1975, these were the only major robot installations in any major American auto assembly plant for many years.(3) Clearly, the decision to go ahead with the commercialization of advanced robot technology in this country was stalled.

Why does the U.S. enjoy a leadership position in manufacturing innovation and not in its engineering application or commercialization?

One reason is that our leadership position in manufacturing innovation has been maintained by a well-developed structure in both universities and government built to support and test the health of the *basic* sciences and the engineering sciences, determining quality by peer judgement. The programs of the National Science Foundation as well as Federal mission agencies have, since World War II, assured the flow of high-quality, innovative, creative research, and maintained a skilled scientific and engineering work force.

But we have never as a Nation, put an equivalent emphasis on the transfer of innovation to its implementation in manufacturing.

There are a number of significant issues that surround commercialization:

1. *Initial investments are high, and industry must perceive that there is an opportunity to realize a reasonable rate of return on those investments.* This can be encouraged by reducing investment cost through tax policy, incentives, and subsidies.

   However, it is not that simple, for such tactics presume the ability to realize the full benefits of productivity gain *through labor acceptance of new technologies*. This acceptance is more readily obtained in growth industries where productivity gains are absorbed by increased product demand rather than by either labor displacement or inefficiency. Such is the situation in Japan today, as is aptly described by Takao Sugawa, president of Sharp Electronics, in his statement, "They do not fear automation, but rather embrace it."(7)

For mature industry now, and inevitably for all industry as we move toward the "manless" factory of the future, automation must displace manufacturing people. Labor acceptance of such productivity gains will become more difficult and costly to obtain.

2. An equally key issue in effecting rapid transfer from innovation to commercialization is reduction of technical risk. Industry must think it can succeed in spite of risk--otherwise, new technologies will never be tried. While risk can never be reduced to zero, it can be lessened through research and development, experience, understanding, and education.

Importantly, implementing innovation is not simply an economic risk, but represents a high personal and social risk as well.

Consider the partnership of the Japanese government and its manufacturing industry. One of the recent programs of the Ministry for International Trade and Industry of Japan (MITI), is its $50,000,000 Laser Project.(8)

This seven-year project, undertaken by a group of three government institutions and twenty industrial companies, is designed to develop expertise and experience in flexible manufacturing and assembly using laser processing. The project is designed first to develop relevant technologies and then to build a model plant where both the technologies and the manufacturing system can be evaluated. This is a process through which all participating companies develop sufficient experience to reduce the technical risk for each participating company before it makes further investment.

There is no equivalent U.S. program addressed to advanced technology as applied to the general manufacturing industries that acts to reduce technical risk. In fact, there is no national methodology whereby such a program could be undertaken in the U.S.--outside of the defense and aerospace fields.

In a short presentation, it is easy to lose sight of the fact that alternate solutions are usually available to alleviate risk, particularly for the short term. Lower labor costs off-shore or out-of-site might provide the means to obtain an alternative short-term productivity gain (cost reduction) to implementing increased automation. Either case, implementing automation or moving off-shore, has the same short-term effect, i.e., increased productivity and loss of domestic jobs.

Assigning blame for the problems of American industry to contrary labor, short-sighted management, or high interest rates is counter-productive. In my view, these are *only symptoms of the problems caused by conditions that precluded the necessary adoption of advanced technology*.

THE UNIVERSITY AS A PARTNER IN PRODUCTIVITY

The technological issues impacting our nation's productivity problems are complex and difficult, involving large-scale and costly programs and equipment. The solutions to these problems will require a partnership of industry, government, and universities that is at least as innovative, intelligent, and flexible as the technology they must control.

Our country's engineering schools, which could have served as a significant resource to the manufacturing community, have not, to any great extent, been effectively used to help solve our national productivity problems.

This situation contrasts radically with that of the industrialized countries of Western Europe and Japan. In these countries, where productivity rates continue to grow dramatically, there has been a long-standing cooperative effort between major manufacturing industries, government, and the technical universities which fuel their growth.

German manufacturing programs, for instance, attract the best engineering students; students who are drawn by the challenge of the work and the opportunity to solve a variety of manufacturing problems that are at once at the leading edge of technology and of practical importance. This contrasts to the situation in our country where, historically, large numbers of bright students have not been sufficiently attracted to careers in manufacturing.

In order for the United States to develop a competitive manufacturing industry, universities must take the responsibility to train a generation of engineers and managers--the "best and the brightest"--to meet the challenges of the next 10 to 20 years. Accomplishing that task is difficult and expensive--and must occur in tandem with a radical change in student skills and the escalating complexity and costs of the manufacturing systems needed in the laboratories.

It is only recently that any major universities in the United States have focused on problems directly relevant to manufacturing.

In order to address this problem, the Rensselaer Polytechnic Institute has created a Center for Manufacturing Productivity to attract some of our best students to manufacturing careers. The work of the Center focuses on finding solutions to industrially-placed projects and problems (although I would prefer to call them opportunities) rather than on either basic research, courses, or curriculum. Applied in an environment that utilizes the broad resources of the university, and funded solely by private capital, the

Center's undertakings are project-problem-driven in the area of manufacturing productivity. The students engaged in the projects are motivated to learn manufacturing technology.

The Center transfers to industry advanced, innovative technology applicable to the manufacturing process in three key ways: first, by providing a source of motivated and skilled graduates who have had extensive experience in manufacturing research; second, by solving manufacturing problems on a timely basis; and third, by offering a range of short courses in order to transfer new technology to manufacturing personnel. It is a true partnership between industry and university.

SUMMARY:

I have traced the past, current, and future trends in manufacturing technology, their implications on productivity and the labor force, and identified some factors that I believe are inhibiting the adoption of new technology in American factories.

- The trend in the technology is toward the development of intelligent machines that communicate with each other, link to control data bases, and produce goods in a flexible system. In short, machines that can derive enough information about the manufacturing process to operate themselves, and create the labor-free factory of the future.

- These intelligent machines will force a distinct change in the relationship between productivity and the labor force. Exploiting fully this new technology will require the development of new partnerships between industry, government, and the university.

- As we move toward the factory of the future, there will be a sharp decline in the overall manufacturing labor force -- both blue collar and white collar. At the same time, there will be a strong demand for a smaller number of highly skilled persons who are able to design and build these complex manufacturing systems, and also for those who will be able to maintain them.

- While the United States has led in the creative development and innovation of the new manufacturing technology, Japan and other nations have excelled in its engineered application and commercialization.

- There appear to be structural problems inhibiting the adoption of advanced manufacturing technology in the United States. The ability to realize the full benefits of productivity gains presumes labor acceptance, which may be difficult (and costly) to gain. Equally important is the need to reduce the perceived high technical risk associated with the rapid transfer of the complex technology from innovation to commercialization.

- Unlike Japan and some of the countries in Western Europe, the United States has no programs applicable to the general manufacturing industry which act to reduce technical risk. Our national efforts in this regard are largely focused on the aerospace and defense fields.

While I know of no simple or, indeed, obvious solutions to our productivity problems, we should begin by:

1) Establishing a national program and methodology which acts to reduce the technical risks of adopting new technology in American factories.

2) Addressing the dislocations in the manufacturing labor force that will follow the movement towards the factory of the future.
3) Educating a new generation of engineers and technologists needed to design, build, and maintain these complex manufacturing systems.

A few weeks ago the television show "60 Minutes" explored the morality of a company abandoning a plant and its surrounding community in order to seek higher profits by manufacturing overseas. We must give companies better options. We must also give displaced labor better options. We are all somewhat dissatisfied with the ability of unemployment insurance, welfare, or Vonnegut's "Reeks and Wrecks" (9) to satisfy the needs of the displaced workers.

REFERENCES:

1. 1981 Worldwide Survey on Industrial Robot Population--Robot Institute of America, One SME Drive, P.O. Box 930, Dearborn, Michigan 48128.
2. Robots That Paint Can Create Jobs, American Machinist, January 1982, p. 18
3. W. K. Weisel, The Robots Role in Productivity, Production Engineering, December 1981, p. 18.
4. American Machinist, November 1[illegible], p[illegible]0, 182.
5. S. Lohr, New in Japan: The [illegible]nless Factory, New York Times, Section 3, p. 1, December 13, 1981.
6. Bureau of Labor Statistics, U. S. Labor Department.
7. W. Arnold, Info Systems, editorial, October 1981.
8. M. Kimura, F. Honda, S. Ozaki and T. Ono, Flexible Manufacturing System Complex Provided with Laser, Proceedings of the 4th International Conference on Production Engineering, Tokyo, 1980, p. 204.
9. K. Vonnegut, Player Piano.

THE NEW MANUFACTURING TECHNOLOGY

TESTIMONY TO THE SENATE SUBCOMMITTEE ON
EMPLOYMENT AND PRODUCTIVITY
WASHINGTON, D. C.
MARCH 26, 1982

GEORGE S. ANSELL
DEAN, SCHOOL OF ENGINEERING
RENSSELAER POLYTECHNIC INSTITUTE
TROY, NEW YORK 12181

THE PAST

o Machines Replaced
    o Physical Labor
    o Specialized Skills
    o Labor Content

o Emphasized
    c Fixed Automation
        Hard Tooling

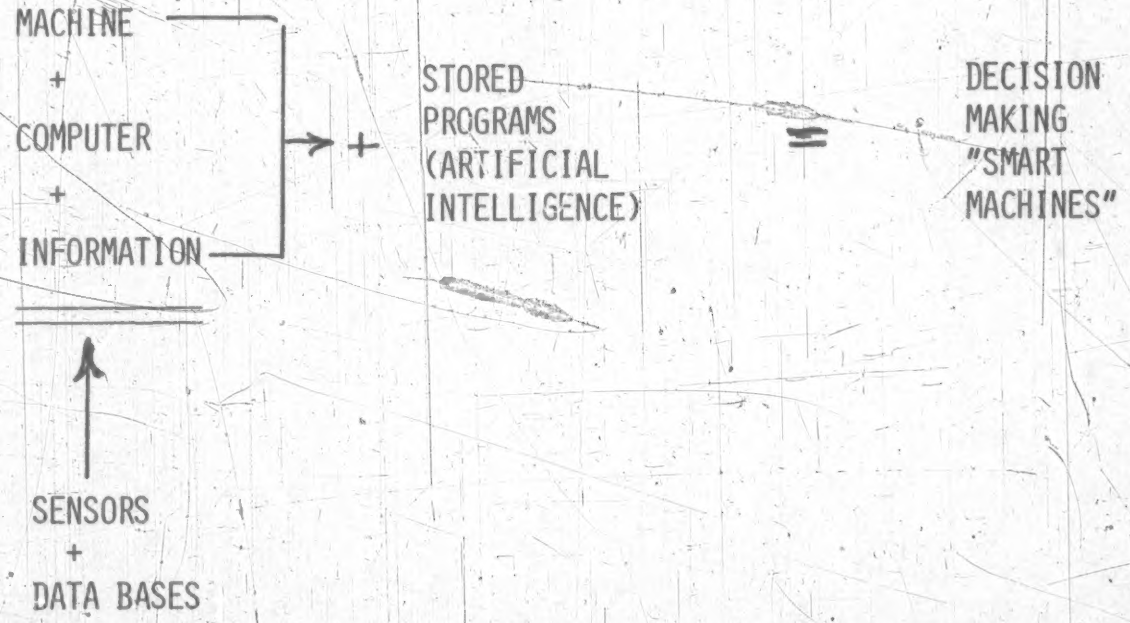
o Increased Product Demand
    o Absorbed Productivity Growth

NEW MANUFACTURING TECHNOLOGIES

o Intelligent Machines
    o Machine + Computer
    o Versatile
    o Learns (Programmed)
    o Robots -- One Example

o Flexible Automation
    o Increased Productivity Will Reduce Labor Force

"SMART" MACHINES



MACHINE
+
COMPUTER
+
INFORMATION

SENSORS
+
DATA BASES

+

STORED
PROGRAMS
(ARTIFICIAL
INTELLIGENCE)

=

DECISION
MAKING
"SMART
MACHINES"

ROBOT

- A Flexible Manipulator
- Mimics Arm
  - Stronger
  - More Precise & Rapid
- Can be Taught
- A Boy Scout
  - Learns Easily
  - Doesn't Forget
  - Reliable
  - Works Three Shifts/Day

TOTAL ROBOT POPULATION (1981)

COUNTRY	PROGRAMMABLE	TOTAL
JAPAN	14,246	67,435
FRG	1,420	11,420
USA	4,100	4,100

SMART MACHINE TECHNOLOGY

THROUGH THE 80's

Evolutionary Changes

As Stand-Alone Units

- Strengthened Intelligence
  - Programs & Sensors
- Improved Precision
  - Speed
  - Load Capacity
  - Maintainability

Combined into Machine-Tool Unit

- Under Computer Control
- An Array of Machines & Robots

Flexible Manufacturing Cells

- Schedule & Transfer Work
- Select & Transfer Tools
- Manufacture & Assemble

FACTORY OF THE FUTURE

- MANLESS & PAPERLESS
- APPLICATION OF COMPUTER & INFORMATION SYSTEMS --
  FROM PRODUCT DESIGN → FINAL ASSEMBLY
- MANUFACTURING CELL 1ST STEP
- OPERATIONS MANAGEMENT & PRODUCTION DECISION PROCESS BECOMES AUTOMATED

PRODUCTION CONTROL

INDEPENDENT OF MAN'S DIRECT INTELLIGENCE

REPLACES WORKERS

FACTORY OUTPUT $\neq f$ (LABOR)

PLANT LOCATION $\neq f$ (LABOR)

$= f$ (MATERIALS AVAILABILITY
MARKET
TRANSPORTATION COSTS
TAX & OTHER INCENTIVES)

MODERN MANUFACTURING TECHNOLOGY

- Innovation

  Creative Development   U.S. Excels -- Why ?
  Discovery

Because U.S. Has

  - Well Developed Structure to Support Innovation

- Commercialization

  Implementation   Japan and Others Excel -- Why ?
  Application

Because Japan Has/U.S. Doesn't Have

  - Ability to Realize Full Benefit of Productivity Gains
    - Labor Acceptance
  - Means to Reduce Technical Risk
    - Experience
    - Education
    - New Generation of Engineers

INITIATIVES

1. Establish National Program to Reduce Risks of Technology Implementation.

2. Address the Dislocation of the Manufacturing Labor Force.

3. Educate the New Engineers and Technologists Who Will Implement These New Technologies.

Senator **QUAYLE**. Thank you very much, Mr. Ansell.

Mr. Edmonds?

Mr. **EDMONDS**. Thank you, Senator Quayle, for this opportunity to testify. Before I begin, I would like to point out that I am speaking for myself today, and that the following testimony represents my own personal views and does not necessarily reflect either the views of the Institute for Energy Analysis, Oak Ridge Associated University, or the Department of Energy.

Senator **QUAYLE**. We will accept and take judicial notice of that qualification. And we usually find personal views much more interesting than institute or association or whoever you happen to be representing. So we appreciate that.

Mr. **EDMONDS**. Thank you.

The subject that I have been asked to testify about is the energy supply sector in U.S. labor productivity in the medium term. This is a subject which has not received much attention, either by researchers or by the popular press. The research which has been done all focuses on the demand side or indirect effects on labor productivity, brought about by the changes in the price of energy. And today, we will be discussing the heretofore neglected topic of supply side or direct effects of energy on labor productivity.

I took the liberty of distributing to you some material which would be helpful to follow along with. It begins with a chart depicting U.S. crude labor productivity over the long term. I felt that it was useful to begin by looking at overall productivity in the United States and trying to gain some perspective. What you see there is a very long-term trend in upward labor productivity growth starting in 1870, with labor productivity in 1972 constant dollars, at around $2,000 per laborer, and by 1980, reaching almost to $10,000. You will find that the experience between 1970 and 1980, which has received so much attention, the negative productivity, particularly between 1979 and 1980, did not characterize the entire decade, and that, back between 1880 and 1890, we have had an entire decade in which labor productivity actually fell, and that between 1910 and 1920, we had a similar experience of a growth rate in labor productivity of about 0.7 percent. I think this is very useful as background to keep in mind when we talk about productivity trends in the United States.

The next chart is more specific to energy. It shows the overall 1977 labor productivity in the United States in dollars per manhour, which is around $12. You see that the energy sector is much more productive than the average; it was around $51. Coal was double the U.S. average at $25, and the oil and gas industry was much more productive than that, at $67 per man-hour.

If you flip to the next graph, however, you will find that of that $12.20 per man-hour in 1977, only 36 cents was accounted for by the energy sector. The reason is that despite the fact that the productivity is so extraordinarily high, and partly because of that, very few laborers work there, and so very little of the productivity in the United States, is explained by the energy sector.

If you flip to the next chart, you will see U.S. energy sector productivity over time, between 1963 and 1977 in units of billions of Btu, the standard unit of energy, per worker. The taller bars are the oil and gas sector, where productivity is higher, and the shorter bars for each year are the coal industry, where productivity was lower. You can see that productivity in the oil and gas industry rises very steadily between 1963 and 1972, and then drops off very dramatically.

What is going on there, of course, is that prior to 1972 when oil production peaked, you had a very different world situation than after the energy crisis of 1973. You had a situation where in the sixties, the Alaskan fields were coming in, and not much effort was put into discovering new oil and gas resources in the United States. It looked like as if lots of cheap imported oil was available. Productivity rose because what discovery activities were going on were becoming more productive. There is technological innovation going on there. After 1973, in the oil prices, you find very rapid drop-off in productivity, because all of a sudden, you are beginning to explore much more than you were before in the United States and you are also finding smaller fields than you were before, so that you are encountering lower grades of resources. Productivity drops off very rapidly, then, in the oil and gas industry for those two reasons. One, you are going back to an activity which you had been neglecting prior to 1973, and in addition, you are running into lower grades of resources.

In the coal industry productivity begins to drop off earlier. Actually, it begins to drop off in 1969. Before 1969, you found productivity increasing for three reasons. First of all, you were getting technological innovation. You were getting continuous mining and longwall mining techniques introduced in the deep mining sector. In addition, in surface mining, you had the tendency toward larger power shovels and bigger drag lines. After 1969, in deep mining, you have the Health and Safety Act which goes into effect, and labor, which had previously been dedicated toward directly productive activity was now set to work on maintaining health standards, and you get an immediate fall-off in productivity between 1969 and 1973.

Similarly, in surface mining, you have the reclamation and conservation legislation coming into effect, and again, labor which had previously been allocated only to the production of coal now has to be used for reclamation. In addition, before 1969, you have a shift toward surface mining from deep mining, and of course, surface mining is much more productive than deep mining.

Finally, after 1969, you have the price of energy going up, which means that rather than the coal industry being a declining industry with small, less productive mines being closed down, you suddenly have exactly the opposite. The price of energy is very high, and small, less productive mines suddenly become profitable once again and they are reopened. That brings in laborers as the industry expands, and there is a tremendous amount of labor unrest—wildcat strikes were rampant in the coal industry, and in the 1977–78 period, you have the longest strike in the history of the mineworkers. So as a consequence of all of those factors, coal sector productivity drops and falls continuously until 1979, at which point it has begun to level off.

If we go to the next page, we see the supply of energy in 1980, which is predominantly oil and gas, 40 quadrillion Btu's of energy is oil and gas, and something less than 20 quadrillion is coal. We expect that things will be different by the year 2000. In a recent analysis done by the Institute for Energy Analysis, looking at the year 2000, you see that oil and gas loses its overwhelmingly predominant role as the chief supply of energy in the United States, and coal expands its role. In addition, nuclear energy becomes a significant factor. In terms of productivity, this means the following. As coal mining, which we noted, was a less productive activity in the United States than oil and gas production—and certainly less productive than nuclear—expands its share of energy supply, you would anticipate that the overall level of productivity in the energy sector would tend to drop, because you are changing the mix. Counterbalancing that, we would anticipate that those negative factors, such as labor unrest and the higher price of coal, which had such detrimental effects on coal productivity, as well as the dislocations associated with the institution of regulations would tend to work themselves out, and that the coal industry would see increased productivity as the penetration of technological innovation such as the longwall mining and the continuous mining continue to increase productivity in that sector.

In the oil and gas sector, we have to be somewhat more pessimistic, because the United States is a region in which it seems fairly clear that we are going to be running into lower grades of resource in the oil and gas industry, so that productivity will be weak in the oil and gas sector.

The nuclear industry, again, is a highly productive industry, but of course, there are questions about it. Recently, we have seen very highly publicized problems in the industry with citing and with licensing. In addition, there may be a few problems that have not been envisioned as the sector becomes a very large sector, and you get to the point where plants are being decommissioned.

On the positive side, as the industry grows, you would anticipate also that you would be benefiting from some standardization in the industry.

Overall, I guess I have to be somewhat pessimistic, however, about energy sector productivity and anticipate that, whether or not it is positive or negative, it almost certainly will lag behind the U.S. average in the future.

Thank you.

Senator QUAYLE. Thank you.

[Material supplied by Mr. Edmonds follows:]

THE SUPPLY OF ENERGY AND U.S. LABOR PRODUCTIVITY TO 1990

by

Jae Edmonds
and
John Reilly*

March 26, 1982

The authors are respectively a senior economist and an economist at the Institute for Energy analysis, Oak Ridge Associated Universities. The following testimony represents the personal views of the authors and reflects neither the views nor policies of either the U.S. Department of Energy or the Institute for Energy Analysis, Oak Ridge Associated Universities.

THE SUPPLY OF ENERGY AND U.S. LABOR PRODUCTIVITY TO 1990

I. INTRODUCTION

The issue of U.S. labor productivity has been of real interest to both researchers and policymakers since the late 1970s when labor productivity showed periods of substantial decline. There have been proponents of numerous theories to explain the cause(s) of this decline and equally diverse opinions as to the likely course of future trends in labor productivity. Some analysts have made much of the role energy has played in influencing productivity. Some have argued that higher energy prices, reflecting energy scarcity has caused a decline in the rate of capital formation and lowered the productivity of labor throughout the economy. There are other analysts who have argued the opposite. All of the research to date has focused on the indirect effects that energy can have on the level of productivity through the energy price. The direct effects of labor productivity through the energy supply sectors has been largely overlooked.

In the course of this paper we will examine the direct role which the energy supply sectors play in the determination of aggregate energy productivity. We will explore energy's role in the context of overall labor productivity trends--both long-term and near-term. Finally, we will look to the future to see what likely trends in energy technology and supply mix will have on overall labor productivity in both the energy sector and economy as a whole.

II. LABOR PRODUCTIVITY IN THE UNITED STATES

INTRODUCTION

The concept of labor productivity is a simple one. It is the ratio of total production to labor required for production. The actual measurement of labor productivity is less simple. Both labor requirements and production can be measured in numerous ways. In the context of this discussion of aggregate labor productivity in the United States, productivity will be defined as the ratio of real gross national product (GNP) to total size of the labor force.[1]

There are numerous factors which exert an influence over crude productivity measure. These can be broken down into two groups: one which influences the quality level embodied in each laborer, and the other which includes all non-labor inputs. A further disaggregation of these effects is included below.

TABLE 1. FACTORS INFLUENCING CRUDE LABOR PRODUCTIVITY

- Labor Quality
    - Sectoral Distribution of Labor Force
    - Rate of Unemployment
    - Hours Worked per Laborer
    - Sexual Composition of the Labor Force
    - Age Composition of the Labor Force
    - Education
    - Experience
    - Health
    - Social, Institutional, and Psychological Factors
- Non-Labor Inputs
    - Capital Accumulation
    - Economies of Scale
    - Technological Change
    - Terms of Trade
    - Other Effects

Attributing responsibility for any change in productivity to these various categories is an interesting and difficult undertaking, but it is beyond the scope of this report to perform an assessment of the contribution of major factors influencing growth in crude labor productivity.[2] The aim of this section is far more modest. It is to observe the historical behavior of this measure over very long periods. This will provide some perspective for viewing current U.S. labor productivity trends, and hopefully free us from using myopic hindsight to look ahead.

LONG-TERM PRODUCTIVITY

The United States was one of the early leaders of the modern industrial world. More significant than its early entrance, however, is the sheer volume of economic activity carried out by the U.S. today. Representing just over 5 percent of the world population, the U.S. is responsible for well over one-fourth of the world's total GNP.[3]

The data used to calculate the long-term historical trends in U.S. productivity were extracted from U.S. Department of Commerce tables of GNP and labor force in Historical Statistics of the United States: Colonial Times to 1970 and Survey of Current Business. The estimates of GNP prior to 1909 were prepared by John W. Kendrick and Simon Kuznets.[4] The values from 1909 to 1980 are official estimates prepared by the Department of Commerce. The margin of error for the figures prior to 1919 is considered to be wider than for post 1919 estimates.

Table 2 lists the historical estimates of GNP, labor force, productivity, and the rates of growth of productivity for the U.S. Because of the uncertain

TABLE 2. UNITED STATES CRUDE PRODUCTIVITY: 1870 THROUGH 1980

Year	GNP (10^9 1958$)	Labor (10^3)	Crude Productivity ($/laborer)	(Percent) Rate of Productivity Growth: Previous 10 Years	Previous 70 Years	From Date to 1980
1980	1006.9	106,800	9428	0.7	1.6	—
1970	722.5	82,049	8806	2.4	1.7	0.7
1960	487.7	69,877	6979	1.1	1.6	1.5
1950	355.3	56,643	6273	3.9	1.4	1.4
1940	227.2	53,011	4286	1.3	1.2	2.0
1930	183.5	48,830	3758	1.1	--	1.9
1920	140.0	41,614	3364	0.7	--	1.7
1910	120.1	38,167	3147	1.8	--	1.6
1900	76.9	29,073	2645	1.6	--	1.6
1890	52.7	23,318	2260	-0.8	--	1.6
1880	42.4	17,392	2438	2.8	--	1.4
1870	23.1	12,506	1847	--	--	1.5

Sources: GNP for 1870-1970 comes from Tables F1-5 in U.S. Bureau of the Census, Historical Statistics of the United States: Colonial Times to 1970, Bicentennial Edition, Part 1 (Washington, D.C.: U.S. Government Printing Office, 1975), p. 224. Labor force for 1870-1970 comes from Table D11-25 in Historical Statistics of the United States, p. 127. GNP and labor force for 1980 come from U.S. Department of Commerce, Survey of Current Business, July 1981.

statistical reliability of the early GNP estimates, the corresponding estimates of crude productivity are expected to contain a substantial margin of error.

As Table 2 shows, the U.S. has experienced rather steady growth in productivity over the long run. The average growth rate of productivity over the entire 110-year period is 1.5 percent per year. The lowest 70-year rate is 1.2 percent (1870-1940) and the highest rate is 1.7 percent (1900-1970).

The short-term rates of productivity growth, as presented for 10-year intervals are sporadic. The lowest measured rate and the only negative value is -0.8 percent (1880-1890) while the highest short-term rate is 3.9 percent (1940-1950), in contrast to the full period (1870-1980), rate of growth of 1.5 percent. In this light, two observations of recent productivity trends can be noted: first, the growth rate from 1940 to 1980 is well above that of the longest period; and second, the rate from 1970 to 1980, at 0.7 percent, is far below that rate. Recently diminished productivity growth rates have stimulated great interest among economists and policymakers alike. Many studies have attempted to define the causes of the recent sharp drop in productivity growth with respect to the relatively rapid growth experienced since World War II.[5] The U.S. still has a very high absolute productivity level, and some economists have interpreted the low 1970-1980 rate as a short-term fluctuation with a negligible long-term effect. However, as Denison explains, the continued slowdown since 1974 has been puzzling and it is now thought possible that this contemporary slowdown may signal a turning point in long-term growth trends.[6]

It should be noted, in counterpoint, that this downturn is by no means unique. Productivity growth rates were equally low in the period 1910-1920 and actually went negative for the period 1880-1890. By itself, then, the poor productivity growth of the past decade is not without precedent.

RECENT PRODUCTIVITY TRENDS

In recent years U.S. labor productivity has received attention because the relatively elevated rates of growth that characterized the U.S. postwar experience have given way to a more checkered pattern of performance. Productivity in the fourth quarter of 1980 was actually lower than in 1977.

Much has been made of this world productivity slowdown, and energy is frequently cited as a major cause of this downturn. The analysis is, however, more complicated, and recent research into U.S. productivity has revealed that energy played a minor role. See, for example, U.S. Department of Energy, Interrelationships of Energy and the Economy, Office of Planning and Policy Analysis, Washington, D.C., and E. F. Denison, Accounting for Slower Economic Growth, the Brookings Institution, Washington, D.C., 1979.

Recent U.S. productivity trends, measured in 1972 constant dollars of GNP per man-hour of employed labor is given in Table 3.

TABLE 3. UNITED STATES OUTPUT PER MAN-HOUR 1976-1981

Year	GNP (billions of 1972 constant dollars)	Man-Hours Worked (billions of hours)	Productivity (dollars per hour)	Average Annual Growth Rate of Productivity
1976	1300.4	151.39	8.59	—
1977	1371.7	156.63	8.76	2.0
1978	1436.9	163.85	8.77	0.1
1979 I	1479.9	167.83	8.82	2.3
1979 II	1473.4	168.71	8.73	-4.0
1979 III	1488.2	169.35	8.79	2.8
1979 IV	1490.6	170.05	8.77	-0.9
1980 I	1501.9	171.41	8.76	-0.5
1980 II	1463.3	169.27	8.64	-5.4
1980 III	1471.9	168.13	8.75	5.2
1980 IV	1485.6	170.06	8.74	-0.5
1981 I	1516.4	171.65	8.83	4.2
1981 II	1510.4	171.43	8.81	-0.9
1981 III	1515.8	171.29	8.85	1.8

Source: U.S. Department of Commerce, Survey of Current Business.

III. ENERGY AND PRODUCTIVITY--THE RECENT PAST

INTRODUCTION

Energy can affect productivity in at least two ways. Both of these effects are through its impact on GNP. First, energy is a produced good (though significant amounts of petroleum are imported by the United States). As such the value added of the energy sectors is an additive component of total GNP. As a consequence, the labor productivity in the energy sectors goes into determining overall labor productivity. Productivity growth in the energy sector directly affects the overall level of U.S. productivity. In addition changes in productivity in the energy sector can influence aggregate productivity indirectly. For example, if it becomes more difficult to produce energy, resources must be bid away from other sectors of the economy, where they are more productive, if energy production levels are to be maintained. This lowers value added in other sectors as well and, hence, productivity. Indirect effects on the GNP are thought to be minor in the long-run, but unexpected short-term interruptions of supply have shown themselves to have more powerful affects on the economy and productivity.

THE IMPORTANCE OF ENERGY SUPPLY TO HISTORICAL PRODUCTIVITY

The direct influence of energy supply sectors on aggregate U.S. productivity depends on both the level of productivity in the sector and on the share of the U.S. labor force employed by the sector.[7] As a consequence, a sector will be more important in terms of labor productivity if it is either more productive or employs a larger share of the labor force.

The energy sector is highly productive. In 1977 the energy sector averaged 51 dollars per man-hour of employed labor while the aggregate economy managed only 12. In terms of the overall economy, however, the energy sector is relatively small. Only 3 percent of value added originated in the energy sector (here defined as the oil, gas, and coal extraction sectors).[8]

There are very few laborers employed to produce energy. The small number is in part a reflection of the extremely high productivity exhibited by the energy sectors. Less than 1 percent of the employed man-hours were devoted to the extraction of energy.

By weighing the energy sector productivity by the share of labor man-hours worked in that sector, we can calculate the approximate fraction of overall labor productivity which can be attributed to the energy sector. This share was 3 percent in 1977. Energy production accounted for only 3 pecent of aggregate U.S. labor productivity. This is little different than in 1967 when energy production accounted for approximately 2 percent of the aggregate level of productivity. In general then, the energy sector is a relatively minor direct determinant of overall labor productivity in the U.S. economy; though, as we have already argued, it may have more pronounced short-term indirect effects on output and productivity.

Productivity in the energy sector is itself an aggregation over energy subcategories. Since oil and gas are so frequently joint products of production operations, they will be considered together as a single energy production category. Historically the other major energy producing sector has been coal. Energy productivity grew rapidly during the 1960s. There are several reasons for this. First, productivity in both the coal and oil/gas sectors was rising. Coal productivity grew especially fast, averaging over 6 percent per year between 1957 and 1967. It exhibited one of the highest productivity growth rates of any sector in the economy. The oil and gas sector averaged 5 percent per year productivity growth, also well above the U.S. economy average.

Ironically coal mining productivity benefited from the fact that it was a declining industry. Coal production grew about one-third slower than the economy between 1954 and 1967. The sector retrenched by closing smaller, less productive mines. Average mine size grew as production lagged behind the rest of the economy. In addition there was a shift from deep to surface mining. Since surface mining is far more productive than deep mining (averaging between two and three times more productive) this shift in composition tended to accelerate labor productivity growth in the industry. At the same time, productivity continued to grow in both deep and surface mining. Underground mining productivity peaked in 1969 at 15.6 short tons per man-day, while surface mining productivity crested a year later at 36.3, fell backwards in 1972, regrouped to finally peak at 36.7 in 1973, and then declined through the remainder of the decade.

While coal benefited from the shift from underground to surface mining, the aggregate energy sector benefited from an overall shift from coal toward oil and gas. The oil and gas sector produces between two and four times more value added per man-hour than the coal industry. All of these trends tended to make the energy sector a leader in U.S. productivity growth during the 1960s. And while its direct contribution to aggregate productivity growth was small, it was a sector on the leading edge of an increasingly productive economy.

During the 1970s all of that changed. Not only did the rate of U.S. labor productivity growth falter and then decline, but the energy sector suffered some of the economy's most depressing productivity losses. Between 1969 and 1979 labor productivity in underground mining fell to half its earlier level.[9] Between 1973 and 1979 surface mining productivity took an equally spectacular drop, falling to two-thirds of its record high level.[10] Because this period was also characterized by a continued shift from deep to surface mining, overall productivity in the coal industry fell to only 70 percent of its 1969 level by 1979. At the same, time both oil and gas production were peaking in 1972, while the coal industry was expanding. This, of course, dampened the productivity gains which the energy sector had achieved during the 1960s through a shift away from coal toward oil and gas. In addition, the growth of productivity in the oil and gas extraction industry, which had been slowing, fell dramatically between 1972 and 1977, declining to a lower level than in 1963.[11] This reflects the depletion of U.S. oil resources and the constraints on natural gas production during this period. Average oil and gas field sizes were falling and marginal field production was encouraged both by higher energy prices following 1973 and by regulation which made such high cost sources as "stripper wells" profitable. The decreasing ratio of production to reserves indicated the decline in productivity of exploration especially in the lower 48 states.

The decline in labor productivity is more complicated to explain in the U.S. coal industry than it is in oil and gas. Deep mining was very dramatically affected by the Coal Mine Health and Safety Act (CMHSA) which was phased in between 1969 and 1973. Beginning immediately in 1969 deep mine productivity dropped. But the productivity drop continued on after 1973 when oil price increases forced up coal prices. This resulted in the failure to close (and even to the reopening of) smaller, less productive mines. The sudden upsurge in coal demand also brought new, younger miners into the industry. These new miners had less experience and higher expectations. As a result, labor unrest swelled Wildcat strikes became common, and during 1977 and 1978 the United Mine Workers of America conducted a 110-day strike, the longest in its history.

Surface mining productivity was eroded by higher coal prices after 1973 for the same reasons as deep mining. In addition, conservation and reclamation laws had much the same effect on surface mining operations that the CMHSA had on deep mining operations. They drew manpower away from mining operations toward reclamation and conservation operations.

IV. TECHNOLOGY, PRODUCTIVITY, AND THE NEAR-TERM FUTURE OF ENERGY

Technological change has played a major role in the increasing production in both the U.S. and the energy sector. The introduction of continuous and longwall mining techniques to deep mines, the increasing size of dragline buckets and power shovel dippers to surface mines, and the introduction of improved discovery techniques in oil and gas exploration, all served to increase productivity growth rates during the 1960s and to slow productivity declines during the 1970s.

While the energy sector's contribution to aggregate U.S. labor productivity is confined to developments in the conventional fuel supply sectors, the future course of energy productivity developments may include major contributions from sectors which are now emerging or are as yet untested.

Such technologies as nuclear electricity generation, shale oil, synthetic oil and gas (from coal), biomass, direct solar power generation, fusion energy, wind power, tidal and wave power, and geothermal power have all received attention. The timing of the introduction and the rate of penetration of these technologies will depend on both the price of energy and the course of energy policy. To get some idea of the potential contribution of conventional and new technologies to future labor productivity, it is instructive to look at potential patterns of energy supply over the next two decades.

To do this one needs to make assumptions, not only about supply characteristics of the U.S. economy, but also about the international setting in which the U.S. participates. Future oil, and coal prices will affect both production and consumption in the U.S.; the energy policies of OPEC, the OECD, and the centrally planned economies, and the state of world economic health. To implement this holistic assessment of U.S. energy supply, we have used the results from a recent study conducted by the Institute for Energy Analysis for the U.S. Department of Energy. The essential conclusions of the study were that oil prices would remain steady and possibly decline from 1980 levels. The pattern of U.S. energy supply which corresponds to this price scenario is given in Table 4.

TABLE 4. U.S. ENERGY SUPPLY 1980 AND 2000

[quadrillion (10^{15}) BTU, percent]

	1980	2000
Conventional oil and gas	40.3 (62)	33.7 (39)
Coal	18.9 (29)	31.8 (37)
Biomass	0.0 (0)	1.7 (2)
Nuclear	2.7 (4)	14.4 (17)
Hydro	3.0 (5)	5.2 (6)
Total	64.8 (100)	86.7 (100)

The change in composition of U.S. energy supply is rather dramatic. The decline in contribution of oil and gas to overall energy supply from 62 percent to 39 percent is counterpointed by the spectacular increase in nuclear energy contribution from 4 to 17 percent and the more modest, but also important, increase in coal's share from 29 to 37 percent. If nuclear power generation is combined with oil and gas production, the combined share of energy generated by these model drops from 66 to 56 percent, while the coal share increases from 29 to 37. In 1977 the oil and gas extraction sector was over two-and-a-half times more productive than coal mining. If it is assumed that nuclear power generation is approximately as productive as oil and gas generation, the compositional shift alone would reduce the level of energy productivity by approximately 9 percent.[12]

In addition to the changes in composition, which imply a productivity loss in the energy sector at about the rate of a half percent per year, there will be technological change in the individual subsectors which make up the energy sector. In the coal industry the downward slide in energy productivity is expected to halt as (1) coal prices stabilize, (2) labor unrest lessens, and (3) the impact of safety, health, environment and reclamation rules is fully accommodated. This will allow the effects of technological penetration by continuous mining and longwall equipment in deep mines, and larger drag line buckets and power shovel dippers in surface mining to continue their upward push on productivity. In addition, some improvements in surface mining techniques for handling overburden are foreseen. All of this is anticipated to return the coal industry to a positive rate of productivity growth in the future. But no one expects productivity growth to match the rates observed in the early 1960s, since the pressure to expand mining operations will not allow the industry the luxury of increasing productivity by shutting down smaller less efficient mines at rates which were possible when coal was a declining sector.

The shift from deep to surface mining will decelerate during this period. According to the U.S. Department of Energy,[13] this is partly due to the Revised New Source Performance Standards which reduce the cost advantage of low-sulfur coal to high-sulfur coal. This will remove another source of productivity growth from which the coal industry benefited during the 1960s. Overall coal industry productivity growth rates are expected to average about 2.25 percent per year.[14]

Productivity trends are less optimistic in the oil and gas extraction sector. Here the exhaustion of domestic resources, coupled with a leveling of oil prices, will mean that labor productivity will likely decline. Advances in the technology of finding oil will not occur rapidly enough to offset the fact that smaller fields will be found; and that less energy will be pumped from each field. All of this means more labor per BTU produced. The discovery of massive amounts of deep gas could change this analysis, but as of this writing such speculations remain just that--speculation.

The nuclear energy sector is a highly productive one. Its productivity has most likely increased over time with the rest of the electric power generation industry, but no statistics exist which allow for the disaggregation of that sector from the rest of the utility sector. It is likely that productivity will continue to be pushed upward as the technology penetrates. Greater experience and standardization of design will tend to move productivity upward. On the other hand, the industry has experienced recent difficulties with the process of licensing and siting, as well as environmental difficulties that have been well publicized. It is very likely that these difficulties have taken their toll on productivity in the nucelar power sector, just as they did in the coal industry. Problems with the decommissioning of power plants after their useful lives have expired could also seriously affect productivity.

It is finally worth pointing out that the two dramatic increases in energy prices has had some positive influences on energy sector productivity. By reducing the demand for energy and stimulating conservation and energy substitution, there is a decrease in the rate of production of exhaustible resources. This slows the rate at which lower grades of resources, which have lower labor productivity, are extracted. As a consequence, conservation and energy substitution have mitigated one of the negative factors influencing labor productivity.

As a final note, the introduction of such unconventional technologies as shale oil, coal liquefaction and gasification, solar electric power generation, tidal wave energy, and biomass are expensive alternatives to the conventional process of energy extraction. They are less efficient providers of energy, which is why they are only now being considered. At low prices, only the easiest, most efficient processes will be used. After all, this is what the energy problem is all about--the degradation of the base technology of energy supply.

V. CONCLUSIONS

Several conclusions emerge naturally as a result of the foregoing discussion. They are:

1. The energy sector is a highly productive sector, with historic productivity higher than the U.S. average, and productivity growth rates exceeding the U.S. average prior to 1970.
2. Because such a small segment of the work force is engaged in the energy sector, trends in overall U.S. labor productivity do not depend heavily on trends in energy sector productivity.
3. The decline in labor productivity which occurred in the energy sectors during the 1970s as a result of regulation, labor unrest, higher energy prices, and the depletion of natural resources, will likely be lessened in the coming decade.
4. Coal mining productivity should begin to increase once again due to the penetration of technological innovations.
5. Oil and gas productivity should continue to be weak as lower resource grades are exploited. This should more than offset technological improvements in the discovery process.
6. The increased use of high productivity nuclear energy will tend to offset some of the productivity losses associated with the shift toward coal and weak productivity in oil and gas.
7. Aggregate U.S. labor productivity will likely rebound in the next decade, though the rate will likely be lower than during the 1960s.
8. It is likely that the rate of productivity growth in the energy sector will remain below the U.S. average during the coming decade, but it will not greatly affect the overall average directly.

NOTES

1. The definition of labor force is cruder than that normally given. It does not distinguish the effects of changing unemployment rates or trends in hours worked per laborer. It is adopted because more detailed labor measures are unavailable over long periods of time.

2. For those interested in pursuing this analysis, see E. F. Denison, *Accounting for Slower Economic Growth: The United States in the 1970s* (Washington, D.C.: The Brookings Institution, 1970); or E. F. Denison and W. K. Chung, *How Japan's Economy Grew So Fast: The Sources of Postwar Expansion* (Washington, D.C.: The Brookings Institution, 1976); or P. W. Jorgenson and E. Griliches, "The Measurement of Productivity," *Survey of Current Business*, 52, Part II, May 1972.

3. Based on 1975 figures.

4. U.S. Bureau of the Census, *Historical Statistics of the United States: Colonial Times to 1970*, Bicentennial ed., part 1 (Washington, D.C.: U.S. Government Printing Office, 1975), p. 216.

5. The Joint Economic Committee, Congress of the United States, presented an extensive report on recent productivity and its future implications in the *Midyear Review of the Economy: The Outlook for 1979* (Washington, D.C.: U.S. Government Printing Office, 1979). Also, see The Conference Board, "Productivity," in *Economic Road Maps*, nos. 1822-1823 (New York, January 1978); Frank A. Weil, "Management's Drag on Productivity," in *Business Week* (December 3, 1979), p. 14; Jerry Flint, "Lagging Productivity: Planners are Stymied," in *New York Times* (27 January 1979), pp. 1 and 28; and Denison, *Accounting for Slower Economic Growth*, among the many studies.

6. Edward F. Denison, "The Puzzling Drop in Productivity," in *The Brookings Bulletin* 15 (no. 2): 10-11.

7. Aggregate labor productivity is simply the ratio of GNP to employed labor force (L). The GNP in turn is the sum of value added (VA) by all sectors. That is

$$GNP = \sum_i VA_i$$

Thus productivity GNP/L can be calculated by

$$\frac{GNP}{L} = \sum_i \frac{VA_i}{L} = \sum_i \left(\frac{VA_i}{L_i}\right)\left(\frac{L_i}{L}\right)$$

which is the sum of sector productivities (VA_i/L_i) times the share of labor force employed in each sector.

8. This excludes such other sectors as uranium mining and hydroelectricity production which are small relative to the other three, as well as refining, transport and distribution activities.

8. This excludes such other sectors as uranium mining and hydroelectricity production (which are small relative to the other three), as well as refining, transport, and distribution activities.

9. In 1969, underground mine productivity was 15.61 short tons per man-day in underground bituminous coal and lignite mines. By 1979, productivity had fallen to 7.90. (U.S. Department of Energy, Energy Information Administration, 1980 Annual Report to Congress, Volume 2, p. 135.)

10. Ibid.

11. Productivity fell to less than 113 billion BTU per worker in 1977 from a level of 186 in 1972. In 1963 productivity had been 119.

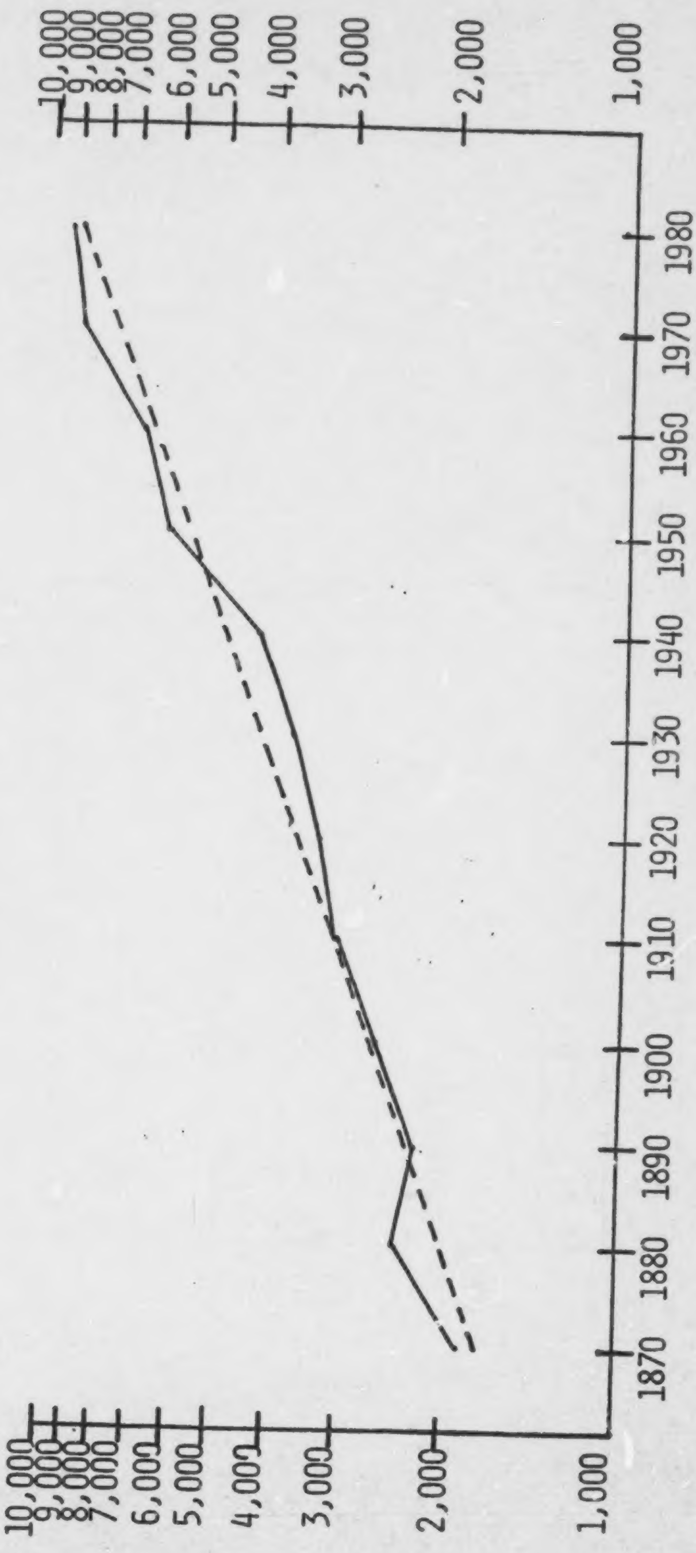
12. Note that if nuclear power is unable to penetrate as rapidly as assumed, the drop in productivity would be greater.

13. U.S. Department of Energy, Energy Information Administration, 1980 Annual Report to Congress, Volume 2, p. 97.

14. Electric Power Research Institute. The Labor Outlook for the Bituminous Coal Industry, EPRI EA-1477 project 1147-1, August 1980, p. 3-43.

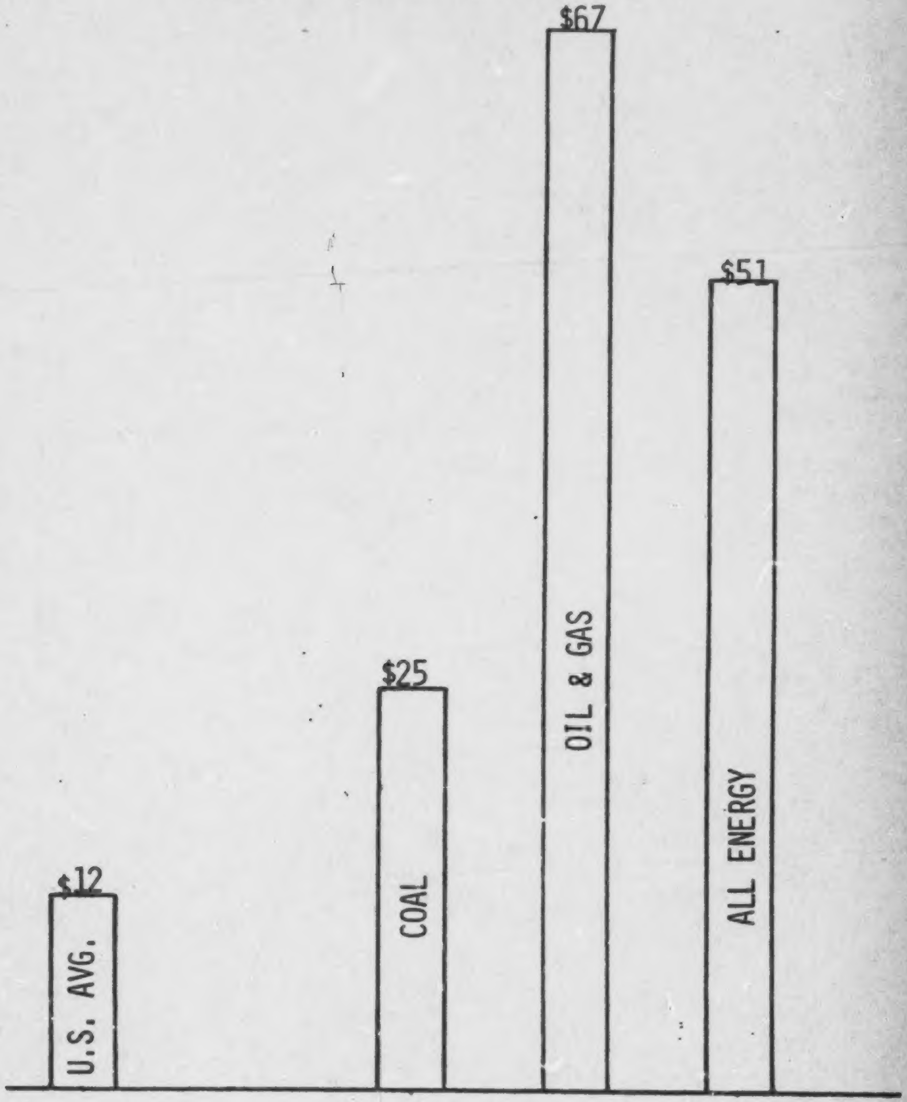
UNITED STATES CRUDE PRODUCTIVITY: 1870 THROUGH 1980

($/LABORER)

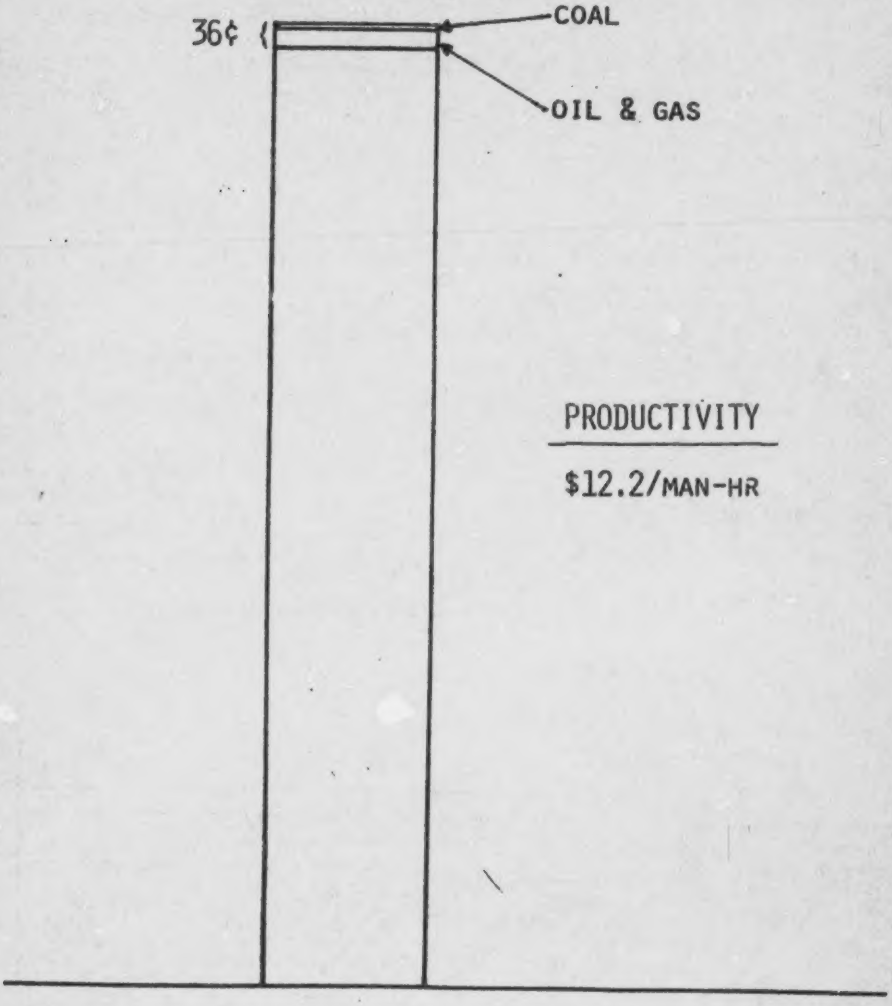


1977 LABOR PRODUCTIVITY IN THE AGGREGATE ECONOMY AND ENERGY SECTORS

(DOLLARS PER MAN-HR)

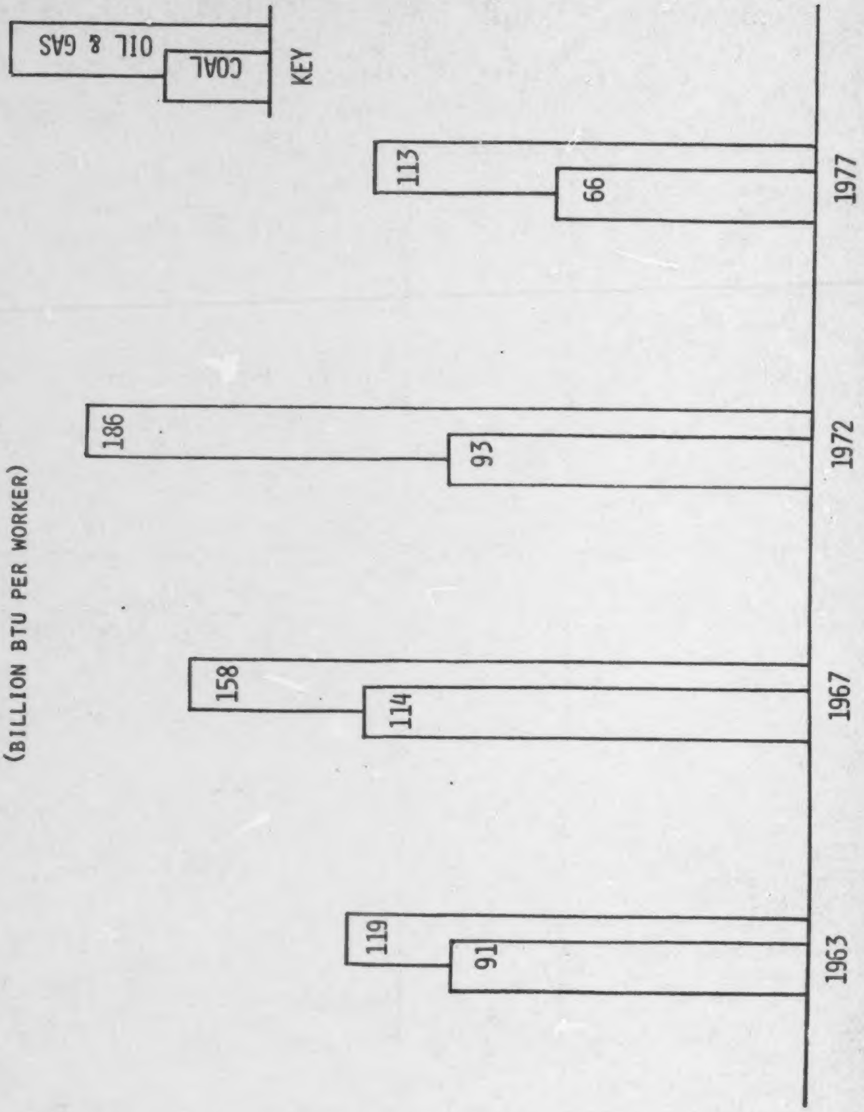


1977 AGGREGATE U.S. LABOR PRODUCTIVITY AND CONTRIBUTIONS BY ENERGY SECTORS

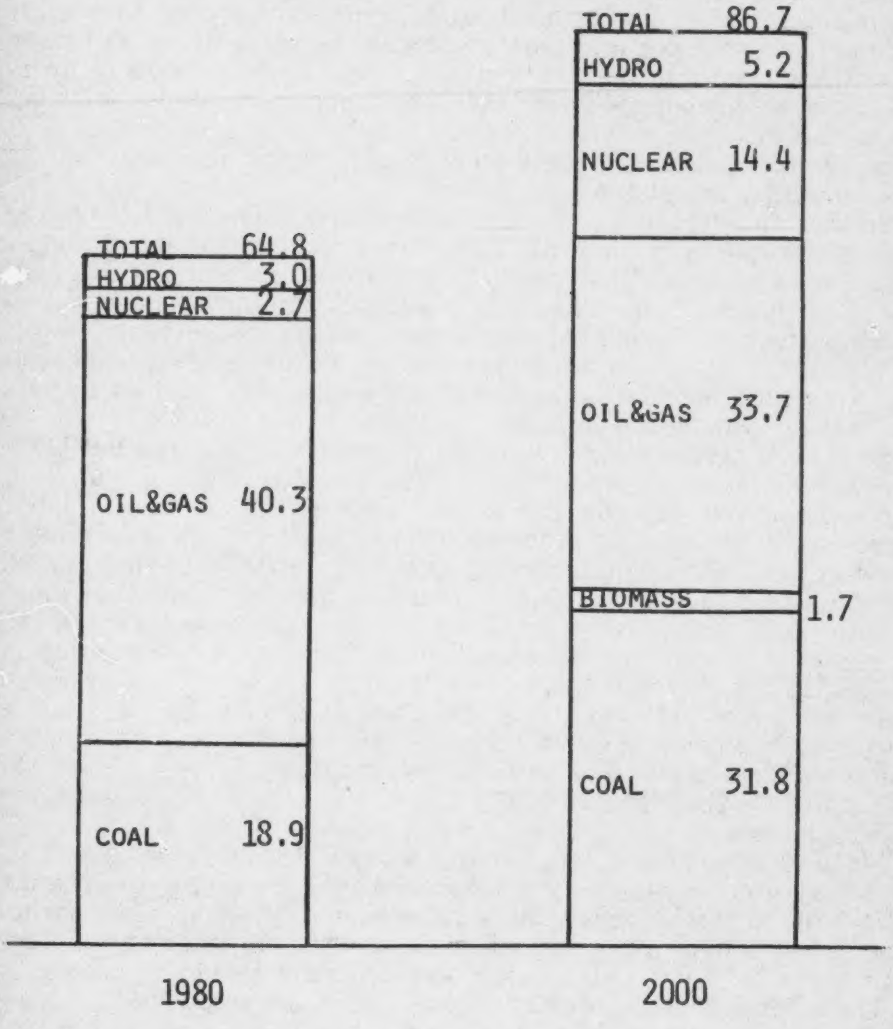


ENERGY SECTOR PRODUCTIVITY: 1963-1977

(BILLION BTU PER WORKER)



U.S. ENERGY SUPPLY 1980 AND 2000
$(10^{15}$ BTU)



Senator **Quayle**. Let me ask just one, quick question on this chart here. Is this total productivity or U.S. crude productivity? Are you talking about total GNP productivity?

Mr. **Edmonds**. Right. Per laborer.

Senator **Quayle**. Now, if you put this in constant terms——

Mr. **Edmonds**. Right, and this is in constant dollars, 1972 constant dollars. I graphed it on a logarithmic scale, partly to keep it on one piece of paper and partly because the logarithmic will show a constant rate of growth as a straight line. So the effects of inflation have been removed from that. It is crude labor productivity because the data, when you go back that far, is not as rich as it is today, so it is productivity per laborer rather than per man-hour as it is currently calculated.

So that this whole trend that you see over this period for fewer man-hours per worker—the work week has been shortening—would tend to make that productivity line a little bit steeper. On the other hand, there is also the effect of unemployment, and you have periods of higher unemployment today as compared with 1950, and of course, you have the entire depression era, when you had very high levels of unemployment, which may account in part for that dip during the thirties.

Senator **Quayle**. What would the chart look like if you put GNP versus man-hours on productivity? Would it still be going up?

Mr. **Edmonds**. We can define the GNP as the product of labor force times the rate of productivity, so you have the labor force growing, as well as productivity, as an aggregate over this period. So you would find that the GNP would be growing somewhat more rapidly than productivity, because you have the impact, first of all, of higher productivity, but also of more workers, as the population of the United States is larger now than it was in 1870, and so we have more workers who are in the labor force now. So the GNP is bigger both because the labor force is more productive, but also because we have more laborers in the labor force.

Senator **Quayle**. Thank you.

Mr. Jackson?

Mr. **Jackson**. Thank you, Senator Quayle. I would also like to express my appreciation to you and your staff for giving me the opportunity to testify today. It is refreshing to find a public forum that is interested in the impact of the genetic engineering industry on the productivity of something besides Frankenstein monsters.

The biotechnology industry is one for which many people have high hopes in terms of its impact on productivity for a number of major industrial sectors in this country, and I believe that those hopes are valid ones. There are really three principal reasons that this industry will have a significant beneficial impact in the next several decades. The first is that the developments which have occurred in the biotechnology industry, primarily in the last 10 years, are of an extremely fundamental nature. This is especially true of what is termed recombinant DNA methodology, or more popularly, genetic engineering.

This particular technology has for the first time opened up the entire genetic repertoire in nature to the experimenter or to the technologist. That is not to say that one can use this ability at the present time to effect any particular sort of genetic manipulation that one wants. But if one understands that genes are the units which code for enzymes and that all of what we think of as the life processes at the cellular level in any organism are catalyzed by enzymes, then it is clear that genetic engineering has made accessible the substance in nature—DNA—which codes for every enzyme which is present in the biosphere. The power of the technique is that this set of enzymes catalyzes all of the chemical reactions which occur in the biosphere.

The second reason that the impact on productivity could be significant is that large and vital sectors of the economy will be affected. Just to give some examples, much of the pharmaceutical industry will be using these technologies. In fact, that process has already started. I am sure you have read in the newspapers about insulin being produced in genetically-engineered microorganisms, as well as interferon and a number of enzymes for various therapeutic processes. This is really just the tip of the iceberg in terms of what is going to be in place by the end of this decade.

A related industry, but distinct in some ways, is that of medical diagnostics and therapy. There are going to be enormous strides taken in diagnosis in particular in the course of the next decade, based upon the technologies that have been developed over the course of the past 10 years, particularly monoclonal antibody technologies, which will allow the detection and localization at unprecedently high levels of resolution of disease states within the body.

A third industry that will be affected is certainly the chemical industry. The chemical industry depends on catalysts. The history of productivity in the chemical industry has in part been the history of finding better and better catalysts to carry out chemical reactions, and enzymes represent a fundamentally new kind of catalyst, at least as far as the chemical industry has been concerned.

Enzymes have been known about and studied for many, many years, but except for a relatively small number of cases, they have simply been too expensive in the form in which they are currently available—as extracts from natural tissues, let us say—to be used in large-scale industrial processes. There really are only about 20 enzymes that are used in large-scale industrial processes at the present time. The biotechnology industry can in principle provide essentially any enzyme found in nature in very large amounts at very low cost. I will return to this point later in my testimony.

Finally, perhaps the largest sector of our economy which is likely to be affected is agriculture. If you think about it, agriculture is part of biotechnology. Everything in agriculture involves biology in one way or another. There will be impacts on a number of different sectors of that industry—animal growth and nutrition, plant growth, crop protection, waste utilization, the ability to utilize resources which must now be disposed of nonproductively. The food processing industry, the processing part of the agricultural industry, will also be greatly affected by availability of cheaper enzymes.

Finally, and in some ways most importantly, the reason I believe the biotechnology industry is going to have a major impact on productivity is that the developments which have occurred so far can now quite clearly be seen to pave the way for another quantum level of development which should occur in about 10 to 15 years. This next quantum level of development is what is termed "directed modification of protein structure." That is to say, we can now isolate the gene that codes for any enzyme in nature, and we can make, in principle, unlimited quantities of that gene, and therefore of that enzyme. But we have only a rudimentary capability at this point to modify the enzyme to make it a more useful substance for many different applications. In principle, it is easy to perform that modification. One has the gene accessible, and we know how to make specific modifications in the coding structure of the gene in order to make specific modifications in the structure of the protein for which the gene codes. What we do not know at this point is which specific modifications to make, because we do not understand the rules which relate the structure of an enzyme to the function of that enzyme. However, the genetic engineering methodology which has been developed over the past 10 years for the first time gives us the tools to find out what those rules are. I confidently anticipate that over the course of about the next 10 years, those rules could be learned, and once they are learned, the practical applications of that technology will follow very, very rapidly.

My own view is that the development of this next genetic engineering methodology is going to have an impact equivalent to the development of genetic engineering itself.

I would like to point out that the biotechnology industry is more than genetic engineering, even though genetic engineering is the key development that has made possible the explosive growth in biotechnology that has occurred so far. In addition to genetic engineering, biotechnology involves microbiology, biochemistry, biochemical engineering, parts of organic chemistry, and plant genetics and physiology. Biochemical engineering will be critical for practical applications of biotechnology in the industrial sector, and plant genetics and physiology will be similarly important for many agricultural applications.

There is not a well-accepted definition for the term biotechnology, but one that I think might be useful is "that set of techniques which allows utilization of significantly improved or novel approaches which employ biological materials."

Now, I said I would come back to talking about enzymes. I would like to do that in terms of giving what I think is the basic rationale for much of the biotechnology industry. This rationale is that it is the ability to produce large amounts of specific enzymes or, more broadly speaking, proteins that is really key in much of the biotechnology industry. There will be many, many diverse applications for the kinds of enzymes or proteins which are being produced, but they all depend upon this one, basic process of making large amounts of specific enzymes cheaply. And it is the newly-developed recombinant DNA methodology that makes it possible to do this. This methodology makes it possible to identify and isolate a particular gene from an organism that codes for an enzyme that one wishes to use in an industrial process, let us say, and insert that gene into a microorganism. This process, if performed properly, in effect transforms the microorganism—which can be grown rapidly and inexpensively by well developed techniques into a minifactory for the production of that enzyme. It is possible to engineer the cell so that essentially its entire metabolism is devoted to producing large amounts of the particular enzyme that is desired. So, instead of having to work hard to produce milligram quantities of enzymes that are available only from nonmicroorganismal sources, it is now possible to think seriously about economically—one can now start producing specific enzymes in ton quantities. In many cases, one is talking about decreases in cost of this class of very specific, very active catalysts of several orders of magnitude over what is available now.

I would now like to say something about the time scale over which I believe some of these developments will occur in particular industries. The first-generation technology—production of large amounts of single, specific proteins—is already starting to be applied in various industries. I believe that it will be quite a widespread, applied, and in some senses, mature technology, within about the next 5 years. This technology will do things like producing proteins for medical therapeutics, vaccines, enzymes for use in the chemical industry and the food processing industry, hormones for use in human health and animal nutrition, and so on.

The second generation of the technology will involve modifying sets of physiological characteristics of microorganisms so that their metabolism can be directed to producing substances such as amino acids, vitamins, antibiotics, and doing a better job at waste degradation—toxic pollutant control, for instance. I think that it is probably going to take until about the end of the decade before that technology becomes really widespread in terms of its full-scale application in industry.

And finally, there is a third generation that can clearly be seen at the present time and will certainly be realized, but which will take longer because there is much less basic information available on which to build. This third generation can be seen for at least two areas. One is crop protection—for instance, modifying crop plants to increase their tolerance to a variety of environmental stresses: heat, cold, aridity, salinity in irrigation water. All of these characteristics of plants have genetic bases, and when one can discover what those bases are, the new biotechnology should make it possible to modify these in a directed fashion.

The second third-generation technology is one I have already described. It is the directed modification of proteins, which is going to make available a fundamentally new sort of catalyst to any industry that uses any type of chemical reaction.

In terms of productivity gains to be derived from this industry, I think there will be both direct and indirect effects. Essentially, biotechnology is going to increase process efficiency in many, many different kinds of processes which use biological components. It can do so by increasing the concentration of the product which is made in a fermentation reaction, for instance; it can do it by increasing the rate at which that fermentation occurs, so that the plant and capital equipment is used at much higher efficiency; it can do it by increasing the yield of a fermentation process, that is the fraction of some feedstock which is converted to the product that is desired.

In the industry there is already a trend toward the development of bioreactors, that is to say, black boxes which have a particular enzymatic catalyst in them. These bioreactors make it possible to produce a product by pumping a feedstock in one side and recovering the final product as it comes out the other side rather than growing a great, big vat of microorganisms in order to produce the final product. In the latter case, the final product must be recovered from what is often a very complex mixture in which the product is present at relatively low concentration.

Not only are bioreactors much more efficient than batch fermentation in many cases, but they are very easily adapted to continuous flow processes and to many types of feedback control which can be used to automate the process. As a result, many processes which are now relatively labor-intensive in the biologicals industry will become much less so with the development of bioreactors.

There will also be indirect effects because the products of the biotechnology industry will make other industries more efficient. For instance, if one looks at the feedlot industry, the production of amino acids and vitamins by the biotechnology industry will make better feed formulation and therefore, faster growth of animals possible. Natural hormones that are produced by the animals in question can be produced much more cheaply by the biotechnology industry and can then be supplied to the animal to make its utilization of its feed more efficient. Vaccines produced by the biotechnology industry against diseases which affect cattle or pigs or sheep will improve the overall health of the animals and therefore allow higher average productivity.

In conclusion, I think the biotechnology will have a significant beneficial impact on productivity. I think that we are starting to see that happen right now in the pharmaceutical industry, and it will become much more broad based in a number of different industries during the next couple of decades.

There are several things I think it is important to do to make sure that this promise does get fulfilled. One is to make certain there will be an adequate supply of trained individuals who are familiar with this technology and who can apply it. There are several key subdisciplines, particularly the molecular genetics of plants and biochemical engineering, which at the present time are seriously at risk in this respect. The demand for individuals with this type of training is so great that not only are all the graduates of the relatively small number of programs that we have in this country being hired, but the professors are as well. We are, in effect, destroying our ability to train individuals in these key subdisciplines.

The second and final point that I want to make is that the reason that the biotechnology industry has been able to advance so rapidly after the key development of recombinant DNA methodology occurred in the early seventies was that the pool of individuals trained in molecular biology and the number of laboratories capable of working in this field was large and of very high quality. That base must be maintained if the biotechnology industry is going to be able to continue to grow and produce at the rate that it has. I think the Congress, working through the agencies of the National Institutes of Health and the National Science Foundation deserves a lot of credit for having assured that that base of basic research was developed over the past quarter-century, and I believe that it is critical that that effort not be abandoned at this point.

Thank you.

[The prepared statement of Mr. Jackson follows:]

IMPACT OF DEVELOPMENTS IN BIOTECHNOLOGY ON PRODUCTIVITY

David A. Jackson, Ph.D.
Vice President and Chief Scientific Officer
Genex Corporation

INTRODUCTION

The field of biotechnology is one of a few areas--computers and robotics are others--that many observers believe will have a major impact on productivity in many industries in the United States by the end of the century. Developments in the area of biotechnology are in fact likely to have both a broad and a deep impact in a number of industries for three principal reasons. First, the developments which have occurred in this area in the past ten years, particularly the development of recombinant DNA methodology or genetic engineering as it is often called, are of a fundamental nature. These developments have for the first time made accessible in a useful way the genetic material (DNA) of any organism. One consequence of this accessibility is that most simple biochemical characteristics of an organism (hormones or enzymes or sets of enzymes comprising metabolic pathways) can now be transferred from any organism, be it an animal, a plant, or a microorganism, to a simple microorganism. The simple microorganism can be grown quickly and cheaply and can be made to produce large amounts of the new hormone, enzyme, or metabolite. Since the new genetic technology makes accessible the genes of all organisms, its applicability is very broad.

The second reason that the new developments in biotechnology are likely to have a major impact is that a number of very large and vital sectors of the economy are in fact part of biotechnology. The agriculture and food industries at both the production and processing levels are certain to be affected. The pharmaceutical industry has already been affected by the new technology, and we have seen only the tip of the iceberg in terms of what the eventual impact is likely to be. Significant sectors of the chemical industry seem likely to be affected because biotechnology will make available at unprecendently low cost a whole new class of highly active, highly specific catalysts--enzymes--for chemical reactions.

The last major reason for the anticipated broad impact of biotechnology is in some ways the most important one. It is that the developments which have occurred thus far can now clearly be seen to make possible a whole new quantum level of development in this field. That level will be the directed modification of genes and thereby of the enzymes for which they code. This capability will make it possible to modify the properties of enzymes and microorganisms so that they can be utilized most efficiently in a wide variety of commercial applications. The development of the capability for directed modification of genes is likely to be as significant in its overall economic impact as the development of recombinant DNA methodology itself.

THE EXISTING BIOTECHNOLOGY INDUSTRY

There is no definition of "biotechnology" or the "biotechnology industry" which has wide acceptance. It is important to recognize that although genetic engineering is a key to many developments in biotechnology, much more than genetic engineering is involved in new developments in biotechnology. In particular, microbiology, biochemistry, biochemical engineering, and several subdisciplines of organic chemistry are all of key importance for many applications. For applications in the agricultural sector, plant genetics and physiology will be very important. For purposes of this discussion, biotechnology will be used to mean that set of techniques which allows significantly improved or novel approaches which employ biological materials to be utilized. Examples of such techniques would be recombinant DNA methodology, cell fusion, enzyme immobilization, directed mutagenesis, regeneration of plants from single cells, and hybridoma formation to produce monoclonal antibodies. The biotechnology industry will be used to mean that set of industries in which products are being or will be produced in the foreseeable future using these processes. Examples of such industries are pharmaceuticals, animal nutrition, specialty chemicals, waste treatment, food processing, and plant breeding.

CURRENT DEVELOPMENTS IN BIOTECHNOLOGY

DNA, the genetic material of all organisms can be thought of as a language. It is the language in which the instructions for the structure and synthesis of enzymes are written. Enzymes, in turn, are responsible for catalyzing virtually all the chemical reactions--the life processes--of living organisms. As with any language, fluency consists of the ability to read, write, and edit the language. Each of these capabilities has been improved by at least a factor of ten--usually much more--in the past decade. The analogies and current state of the art are:

Language Element	DNA Analog	Capability Today	Capability in 1972
		(events per man week)	
Reading	DNA Sequencing	1000 letters	less than 1
Writing	Chemical Synthesis of DNA	10-50 letters	less than 1
Editing	Recombinant DNA Methodology	1-5 editing steps	zero

From this table, it is clear that there has been a huge productivity increase in the past decade in the vital ability to read, write, and manipulate the language of DNA. The current rate limiting step in using the language of DNA is in the writing step. However, major improvements in both instrumentation and chemistry are currently being introduced and it is clear that within two years an improvement of at least another order of magnitude will have occurred.

The new fluency with the language of DNA has allowed very rapid development of several new applications of biotechnology and the prospect of a number of additional ones. Several major trends and the timing of their impacts can now be discerned.

The overall rationale for applications of biotechnology in the commercial sector can be summarized as follows. Production of large amounts of enzymes (or more broadly proteins) is what is important. Most applications of biotechnology ultimately involve producing an enzyme (or protein) with specific properties in large amounts at low cost. The enzyme could subsequently be isolated and used in a bioreactor or as a catalyst in some other process, or it could be left in the microorganism so as to confer some specific physiological characteristic on the microorganism (e.g. ability to degrade cellulose or make alcohol). There will be many diverse end uses for enzymes, the necessary (but not generally sufficient) prerequisite for all of which is some method for making all enzymes (proteins) cheaply in large amounts. Recombinant DNA methodology is such a method. It is for this reason that recombinant DNA methodology is the key to much of biotechnology. Recombinant DNA techniques allow the isolation of the gene for any enzyme found in nature and its transfer to a microorganism. The microorganism can be genetically modified so as to become a mini-factory for the production of that enzyme.

Most of the early applications of biotechnology will require only the isolation of a gene and its subsequent transfer to and expression in a microorganism. This now relatively straightforward technology can be used to produce hormones such as human insulin and human and animal growth hormones, anti-viral substances such as the various human interferons, vaccines against many viruses (hepatitis B and foot and mouth disease vaccines have been produced), vaccines against bacterial diseases, and enzymes for a variety of applications in the medical, chemical, and food processing industries. Many of the products produced by this first generation technology will be essentially new products, substances found somewhere in nature but very expensive to isolate from their normal sources. As genetic engineering methods become more sophisticated, it will become economical to produce proteins of lower cost. As this happens, a number of proteins currently isolated from tissues or blood will be produced in microorganisms.

Dependent upon the success of this first generation technology are several types of downstream applications which are now developing rapidly. One is the use of immobilized cells or enzymes in various types of bioreactors so as to allow a continuous rather than a batch mode of operation. Continuous processes tend to require less capital investment in plant and equipment, to have lower labor requirements, and to be more amenable to automated controls than batch processes for the same products. There is now considerable developmental work in this country, Western Europe, and Japan on many types of bioreactors, on a variety of approaches for immobilizing the enzymatic catalysts in them, and on a variety of sensors (many of which also utilize enzymes) to monitor the performance of the bioreactors and other steps in the total process. Many examples of this first generation technology and its dependent downstream applications will be operating in plants in this decade.

A set of second generation technologies involves doing more than simply producing a large amount of a single enzyme in a microorganism. They involve modifying several physiological characteristics of a microorganism in a coordinated way. In general, this means not only inducing the organism to make large amounts of several enzymes, but also altering a number of regulatory mechanisms in the cell. Such organisms will be used to produce more efficiently a range of substances that can currently be produced by microorganisms. These substances will include amino acids and vitamins (primarily for use as animal feed supplements), a variety of industrial chemicals, solvents, and surfactants, and various natural polymers for use in applications ranging from food thickeners to plastic bases to tertiary oil recovery processes. Many of these applications are in advanced stages of development at the present time and will be commercialized during this decade.

A different type of second generation technology, likely to be of considerable importance in the production of new antibiotics, involves the technique of cell fusion. In this technique, cells of two different microorganisms which cannot normally exchange genetic information are induced to fuse with one another. Under appropriate conditions, a relatively stable hybrid microorganism can be formed containing the genetic information of each of the parents. If each of the related organisms has the capability to synthesize a different but related species of antibiotic, a mixture of enzymes and antibiotic precursors of each pathway will be present in a single type of cell. Under these conditions, there is reason to believe that a variety of analogs of these antibiotics may be formed. Many of these analogs will be different from anything produced naturally by a single microorganism, and so may have novel and potentially useful properties. Substantial effort is being devoted to the approach by several pharmaceutical companies, and the chances for success in this decade seem good. This approach can also obviously be coupled to the more conventional genetic engineering approach described above to enhance the efficiency of production of any new antibiotics produced.

A third generation technology which will have major economic impact is the genetic engineering of crop plants to improve such characteristics as herbicide resistance, salinity and aridity resistance, and tolerance to extremes of heat and cold. Improvement in any of these characteristics for a major crop species would have significant economic impact.

The techniques specific for effecting genetic alterations by genetic engineering techniques are not nearly so well developed as for higher plants as they are for microorganisms for two principal reasons. The first is that higher plants are much more complex genetically than are microorganisms. The second reason is that much less effort has been devoted to research on the molecular genetics of higher plants than of microorganisms. The relatively primitive state of our knowledge of the molecular genetics of higher plants makes it seem likely that major, commercializable advances in this area will not occur until late in the 1980's at the earliest.

Another third generation technology which will have its major impact in the 1990's is the directed modification of proteins. The ability to biosynthesize enzymes whose structure is modified in specific ways so as to optimize them for particular applications will probably be necessary for really widespread application of enzymes in the chemical industry. At present, there is not the knowledge base concerning the relationship between the structure of an enzyme and its function that will be required for directed modification of enzymes to succeed. However, genetic engineering provides the tools to seek the knowledge needed, and this will undoubtedly be an extremely active area of basic research during the next few years. Once the requisite understanding is acquired, commercial applications will follow very quickly.

PRODUCTIVITY GAINS

Developments in the biotechnology industry should have beneficial impacts on productivity in a number of direct and indirect ways. Several types of direct improvement in productivity are possible, all of which result from one type or another of increase in process efficiency. For example, a major objective in the biotechnology industry is to design genetically engineered microorganisms which convert a given feedstock to a given product at a higher final concentration of product than a conventional microorganism can. To the extent that the process otherwise remains the same, a productivity increase in terms of output of product per unit input of labor will occur. In addition, increases in the final concentration of product frequently have beneficial secondary effects in product recovery processes in terms of higher throughput and lower equipment and labor costs per unit product, so that a double benefit is realized. Genetically engineered microorganisms can also be designed to convert a given amount of feedstock to a given amount of product at a faster rate than conventional microorganisms. Increase in rate of production can have a major impact on productivity of either batch or continuous processes, since the plant and capital equipment as well as labor are utilized more efficiently. Finally, genetically engineered microorganisms are typically designed to utilize the feedstock more efficiently or to utilize a lower cost feedstock than can be done in a conventional process.

In addition to direct effects on productivity, there will be a number of indirect ones as well. Consider the impact of products produced by genetically engineered microorganisms on productivity in the feedlot industry. Amino acids and vitamins produced by genetically modified microorganisms will allow optimal, cost-effective formulation of the feed for maximum weight gain. Species-specific growth hormones produced from bovine or porcine or ovine genes introduced into microorganisms may allow the feed to be utilized more efficiently. Vaccines directed against common animal pathogens will insure lower mortality and morbidity and greater average weight gain. Similarly, there are a variety of ways in which the biotechnology industry will increase the productivity of other industries by making available new or lower cost labor saving products and processes.

OTHER CONSIDERATIONS

The necessarily brief and general description of the biotechnology industry presented above does not deal with a number of related topics that might have been considered. One of these is so important that it deserves explicit mention. The issue is that of the knowledge base and the trained personnel that will make possible continued rapid progress in the field of biotechnology. The principal reason that so much progress has occurred so rapidly following the development of recombinant DNA methodology in the early 1970's is that there was a very strong national base of knowledge, trained personnel, and facilities on which to build. The Congress, working through the agencies of the National Institutes of Health and the National Science Foundation, deserves a great deal of credit for having supported and fostered the development of that base. It is no accident that some specific subdisciplines of biotechnology are considerably more advanced than others. There is a good correspondence between the research and training support given to a particular subdiscipline over the past twenty five years and the rapidity with which that subdiscipline has been able to take advantage of and build upon the fundamental breakthroughs which have occurred. For instance, research in molecular genetics of bacteria has been well-supported and progress in this area has been extraordinary. Conversely, support for research on the molecular genetics of plants has been poor and progress in this area, which is of vital economic importance to the country, has been much slower. Even more serious for the future is the fact that the relatively small number of good laboratories in this area in universities are being dismantled because demand by industry for their leaders as well as their graduates is so high. We are fast reaching the situation in several key subdisciplines where the resources and people to train the next generation of scientists and to improve the knowledge base so that future progress can continue will be wholly inadequate. Any serious expectation of the biotechnology industry being able to fulfill to its current great potential must recognize that the health of the basic research apparatus in American universities is of vital importance in this endeavor.

Senator QUAYLE. Thank you very much.

Mr. Jackson, has biotechnology commercialized to the point where agricultural concerns or energy concerns could utilize the work that you are doing, or are we really still in the R. & D. aspect?

Mr. JACKSON. With respect to energy, we are pretty much at the R. & D. stage, although there are some applications in the area of tertiary oil recovery, for instance, which are being commercialized at the present time. As far as agriculture goes in terms of anything like the genetic modification of plants at the molecular level, we are still in the R. & D. stage. However, there are microorganisms which have been made to produce novel types of biological insecticides which are being used commercially right now.

Senator QUAYLE. What is the size of the biotechnology work force in the Nation? Do you have any numbers on that?

Mr. JACKSON. I really do not. It depends very much on your definition. If what you are talking about is the biotechnology industry that you read about in the newspapers in terms of genetic engineering, I would estimate that the work force is now in the neighborhood of 4,000 to 5,000. If you are talking about the work force of the industries which are going to be and are starting to be very much affected by this, it is very much larger, obviously.

Senator QUAYLE. Mr. Edmonds, did I understand, when you were going through your graphs there, that one of the reasons for the decline in productivity in coal was the passage and adoption of some of the laws and regulations that affect the coal industry? Did I glean that from your testimony?

Mr. EDMONDS. Yes.

Senator QUAYLE. I wonder if you might be able to expand on that regulatory impact on productivity, particularly the coal industry, and as we look at the future of the coal industry, according to your charts, it looks like it is going to expand, and if the regulatory aspect is going to be an inhibiting factor to gaining productivity, I think we need to be a little bit more knowledgeable about it.

Mr. EDMONDS. I think there is a fair amount of agreement among analysts that in 1969, when the Health and Safety Act began going into effect, that this did have a negative impact on productivity. You took laborers away from directly productive activities, and you set them to work, maintaining health and safety.

Now, you cannot be in two places at one time, so this did have a negative impact. The continued decline in productivity in the coal industry, however, after 1973 in deep mining, has to be attributed to other factors. I think basically, what you are paying is a once-and-for-all cost. You are taking a certain segment of the labor force and setting them to a task which is not directly productive in terms of tons of coal mined. And so, I would not anticipate that productivity in the future would suffer the same negative impacts as it did in that initial introductory period. The same thing in terms of surface mining; you have the reclamation and conservation legislation that was passed, and this, of course, reduced productivity in surface mining almost as dramatically, although not quite as dramatically, as in deep mining, and for exactly the same reasons. You have to begin moving the overburden around, and you are setting a segment of the labor force to work in an activity that had previously not been required. Once you have done that allocation of the labor force, I think you then begin getting back to a point where technological innovation becomes the dominant element.

Senator QUAYLE. You mentioned on page 17 of your testimony that conservation has added greatly to efficiency and productivity in the energy sector. I wonder if you might amplify on this and say whether we should and can continue to help productivity growth by promoting conservation over the next few decades.

Mr. EDMONDS. Conservation does have a positive impact on energy productivity, in the sense that if you consume less, then of course, you need to produce less, and you encounter lower grade resources less rapidly than you would otherwise—oil and gas is a classic example—or in coal, you do not need to open up these small, less productive mines. As a consequence, you find that you have avoided a productivity dropoff, and of course, conservation is induced by higher energy prices, has some positive aspects to it in terms of energy productivity.

Senator QUAYLE. When we look at the international competitiveness in the energy arena, is productivity a key element or are we really talking about availability of resources? What kind of a factor is the actual productivity going to play in our international competitive advantage or disadvantage in the energy field?

Mr. EDMONDS. In terms of the competitive position of the United States, of course, we are an importer. We import a significant amount of energy in the form of oil today—that, we anticipate to continue for some time in the future.

Certainly, if we were more productive, for example, in the oil industry, and we were not encountering lower grades of resources, I do not think that this would be the case at all. If we, for example, were fortunate to find large quantities of a biogenic gas that some scientists forecast will be found if you go to drilling depths below 30,000 feet, that there are large amounts of natural gas available with potentially high flow rates. If, for some reason, this turns out to be true, of course, it would increase productivity remarkably, and would completely change the competitive position of the United States in terms of energy. So productivity does play an important role. Partly, it is a motivating role, but also, you see productivity changes in the energy sector as a consequence of the natural setting—for example, the decline in productivity in oil and gas is a consequence of the fact that we have found most of the easy oil in the United States, and we are coming now to the hard stuff.

Senator **QUAYLE**. One final question. I believe, at least in your summation, there was no mention of solar energy and its productivity, and also synthetic fuels. I wonder if you might comment. Is there any future in those two, and if so, where do they stand as a relationship on the productivity standard?

Mr. **EDMONDS**. Certainly, there is a future for them, and a very big future. Let's talk about synthetics first. Coal could be used not only directly as a solid fuel, but can also be changed into liquids and gases. The productivity implications of that are pretty clear. First of all, you have got to mine it. Then, after it is mined, you have to do something with it to change it into oil and gas.

So, labor productivity in the coal sector, of course, as I noted, is lower than in the overall energy sector. That means that as you shift to coal to make synthetic fuels, as we anticipate that there will be a synthetic fuels industry by the year 2000, and a much larger industry after that period, we are going to have declining labor productivity, because you are shifting toward a lower productivity source of energy, and then you have to have labor input on top of that, so that the synthetic process for making liquids and gases will certainly be a lower productivity activity.

Solar energy was excluded because I was focusing on the medium term. I was focusing on 1990 and possibly as far out as 2000. In terms of direct contributions to energy supply, say, as a source of electricity, it is negligible. It does not show up in terms of quadrillion Btu at all. There are other types of solar which I would include as having the same beneficial aspects as conservation. In some ways, it is difficult—passive solar, for example—to talk about the difference between that and conservation. Certainly, statistically, it is very difficult to disaggregate those differences.

I would anticipate that while solar is a very capital-intensive activity it may well have fairly high labor productivity.

Senator **QUAYLE**. Thank you.

Dr. Ansell, I believe in your statement, you talked about how the U.S. auto industry started down the road of robots and then stopped. I presume it stopped because of labor resistance, primarily.

Dr. **ANSELL**. That is my opinion.

Senator **Quayle**. What can we do to alleviate labor resistance to this new technology? Do you have any thoughts on that?

Dr. **Ansell**. I do, but they are somewhat complex. I think, if you will forgive me for a slight digression, Senator, the problem in discussions of this type is that we do not predict discontinuity easily, while we can predict continuous change readily. And yet, you heard the three of us each describe the impacts of productivity changes under very different terms and bases.

The problem we have is, when you ask about solar and renewable resources and synthetics, you consider projections based upon what is occurring now, and as a result, very accurate. Mr. Jackson speaks about bio-engineering, which offers a totally different view of how we can produce synthetics in bio-engineering, on which no prediction can be made from past experience. You listen to me talk about new manufacturing technology and its impact on productivity. The only generic common statement among the three of us is that every change in increased productivity will call for fewer, but much more highly skilled people. And by "fewer," I mean significantly fewer. Mr. Jackson talked about 4,000 people currently in the bio-technology labor force, a basic technology which will affect total manufacturing much more so than intelligent machines. We listen to the issues of labor productivity in the energy business, in which the changes in the productivity of an employee in that business, have no measureable effect on the total, national labor force. It is too small a market.

So the question you now ask must be considered in terms of discontinuity of the labor force. I think the United States is in a position where it is clear that its labor needs will continue to decrease, getting smaller as time goes on. The chart on labor productivity that was shown by Mr. Edmonds is an exponential chart. The rate of growth for productivity is really the inverse of the number of people we need working over the fraction of their lifespan. My testimony to you, sir, is that 20 years from now, we will probably need only a very small fraction of our current labor force still working.

I suggest that we should make it easier for people to leave the labor force or easier for them to work a shorter portion of their lifespan because we truly will not need them. Currently, our society is not oriented in that direction. Indeed, proposed legislation has been introduced to lengthen the work life by extending the retirement age and by exerting pressure to reduce the educational timespan of young people.

So I do not have the answer for the autoworker in Detroit who will be displaced by labor-saving devices and automation. Certainly, there is not much choice, because either we displace the worker with more competitive machine tools, or we displace the worker by a less expensive worker overseas, or by an overseas corporation, who is able to accept high-technology machine tools.

So there is no simple answer to what you are discussing. This committee has a history of approaching the problem of labor displacement, in what were very creative ways 40 years ago—unemployment insurance, different work structures. But it has not had the equivalent impact on the social structure since. I think it is time we start approaching the nature of the social contract.

What I mean to say to you, sir, is that I do not believe that we still have a direct linkage between a person's labor and our wealth. The output in this country is no longer labor connected. On this basis, we begin to understand some issues more clearly. Nothing in the United States which has not shared in productivity growth is affordable by individuals without Government intervention. The kinds of things that have not shared in productivity growth are housing, education, medical service delivery. All of these have required massive Federal intervention to continue to provide them for our population. All other areas which have shared in the growth of labor productivity—televisions, automobiles—if you will. Hard goods are no longer measures of wealth and privilege. Those are items in which all the population shares. The items that are truly difficult to provide for our population are the ones that are labor intensive and have not shared in productivity growth. Even in the primary profession of this Congress, law and legal services, there have been multiple and rapid increases in productivity gains. Gains of the same type I described previously which were associated with the intelligent machine in the factory. It is that gain in productivity that has enabled the population to still purchase legal service. These are the types of change which tell us, and tell you, too, that it is not a question of displacing labor from one market to a different one. It is not the view that the service industry will need more people. For example, you have been told that we are going to need lots of computer scientists. We will not, because those represent low-level skills. Those are the skills that intelligent and smart machines will do easily. While machines do not have intellect and are not creative, they can decide and make decisions intelligently. Jobs requiring those decision skills have made up the bulk labor force that has been generated in the service sector. But we are right now in a revolution. It is an intellectual revolution, an intelligence revolution, in which machines will be able to do fairly smart decisionmaking. They will not be able to provide creativity, and they will not provide the highly skilled and creative people we will need for new industries like bioengineering, biochemical engineering, and advanced manufacturing systems. We have to encourage and develop a few people with special skills. We have to insure the basic health of our basic sciences. But we also have to devise a methodology that allows the bulk of the labor force to survive in this arena as companies adopt competitive manufacturing technology.

Senator **Quayle**. That goes to your first point on the initiatives: Establish a national program to reduce the risks of technology implementation.

Dr. **Ansell**. That is right.

Senator **Quayle**. And basically, what you are saying is that the history of this committee in dealing with unemployment, et cetera, has been in response to unemployment compensation, TRA, et cetera, but now as we look to the future, if we are going to be competitive and enhance productivity, we are going to have to look at a different social contract, a dramatic change in the lifestyle of our work force.

Dr. **Ansell**. That is correct.

Senator **Quayle**. And furthermore, you are indicating that it is going to take a significant amount of attention of our Government to have that interaction with the business community and labor, education, et cetera, to get that cooperative attitude that is necessary to see this transition take place as smoothly as possible.

I wonder if you might tell us how is it that Japan is able to have this transition now, because I believe in your testimony, you said that two-thirds of the robots are in Japan. So they have been able to have this acceptance of technology development more readily than the United States. Now, I know the historic and cultural and social differences between our country and their country, but as we look at an implementation of technological advancement, what is it that makes this more readily acceptable in Japan rather than the United States?

Dr. **Ansell**. If you believe the popular press, it is lifestyle and social structure. If you look at the facts, it is only partially due to these reasons. It is very easy to accept productivity improvement by labor and management in an industry which is not fulfilling product demand. So, if a work force in a factory can double its output no one is laid off. The gain in output simply fulfills an unsaturated market. But we have in the United States a number of saturated markets whose manufacturing industries have employed a large number of our workers. In the United States we have purchased at least 10 million automobiles a year, plus or minus 20 percent, for the last 20 years. The Japanese expanded their automobile production for the export market, displacing the U.S. producer, hence for the Japanese an unsaturated automotive market. Domestically, the American automotive industry is looking at a saturated market. So we are dealing with the question of the ease of accepting productivity gains when it is easy for people, when it is simply a matter of adding new business. It is very easy to talk about bioengineering, because at this point you can produce all the insulin you want cheaply and have a market for it. But at some point you are going to saturate that market. It is very easy to talk about the effect of word processors and the information explosion producing jobs for people. But if you look at other aspects of the white-collar labor force, where the information output has saturated the need—department stores, insurance companies—the effect of productivity gains has been to replace the labor force. So we are not dealing so much with a different social structure as we are dealing with the relative balance between gains in productivity and the demand for the output.

These issues are rapidly becoming very difficult, Senator, because we are looking at a sequence in which at the point that we can disconnect labor content from output, there becomes no limit to output except the availability of materials, energy, and investment capital. There is no longer a relationship between how hard you work and how many goods and how much capital you produce. That is the change in social contract that we have to address. It is an extremely difficult one that does not fit any of our experience. Never in the history of our civilization have we ever had the growth of wealth on a generic scale, a broad-based human scale, which is disconnected from work. That is the issue that this committee really must face, and it is not an issue that is easy to handle in the short term, nor really fits our processes. But it is one that we have got to begin to look at and start doing things that are consonant with it.

Senator QUAYLE. Well, I certainly thank this very interesting panel. You have made a major contribution to this committee, and I certainly anticipate working with each one of you in the future. I think you have had some good ideas for the future, and I certainly thank you very much.

Our next panel is Mr. Straw of the Communications Workers, Mr. Birch of the Massachusetts Institute of Technology, Mr. Kutscher of the U.S. Department of Labor, and Mr. Fechter of the National Science Foundation.

Mr. Straw, welcome.

STATEMENT OF RONNIE J. STRAW, DIRECTOR OF DEVELOPMENT AND RESEARCH DEPARTMENT, COMMUNICATIONS WORKERS OF AMERICA, WASHINGTON, D.C.; DAVID L. BIRCH, DIRECTOR, MIT PROGRAM ON NEIGHBORHOOD AND REGIONAL CHANGE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; RONALD E. KUTSCHER, ASSISTANT COMMISSIONER, OFFICE OF ECONOMIC GROWTH AND EMPLOYMENT PROJECTIONS, BUREAU OF LABOR STATISTICS; AND ALAN FECHTER, DIRECTOR, SCIENTIFIC AND TECHNICAL PERSONNEL STUDIES, NATIONAL SCIENCE FOUNDATION, A PANEL

Mr. STRAW. Good morning, Senator. I did not know whether I was in the right hearing room when I heard the previous speakers talk about intelligent robots and the fact that labor does not contribute anything to productivity. They must be in a different country than I am.

Senator QUAYLE. That is why you are here.

Mr. STRAW. Good enough.

I am here to present the testimony of Glenn Watts, who is the president of the Communications Workers of America. He apologizes for not being here, but an unforeseen commitment came up, and he sends you his warmest regards. I will present a condensed version of his statement and submit the full statement for the record.

Senator QUAYLE. The full statement will be incorporated in the record.

Mr. STRAW. My name is Ronnie J. Straw, and I am the director of the development and research department of the Communications Workers of America. We represent over 600,000 workers and administer in excess of 700 contracts. Given the technical nature of the telecommunications industry, we have been able to observe firsthand the effects of new technologies on the work force, and we want to share with you our views on employment and training implications.

In recent years, many American workers have observed firsthand the rapid introduction of new technology into the workplace. New technology can provide a host of benefits to our Nation. New technology can lead to improved standard of living, enabling us to enjoy a greater number of improved products and services. In the workplace, developments in technology can improve working conditions and open up new jobs.

But our eagerness to reap the benefits of technological change should not blind us from its possible costs. Businesses generally promote new technology in a shortsighted attempt to decrease costs, paying little or no attention to the human effects of innovation. Advancements in technology can have strongly adverse effects on workers by reducing skill requirements, fracturing and eliminating jobs, fostering mental and physical stress, and creating health and safety problems. Workers can be heavily monitored and controlled by management, and by machines, causing a dehumanization of the workplace. These problems are being addressed in the telecommunications industry and are typical of those which will arise as American industry brings the new systems on line. I believe the difficulties that we have encountered, and the methods we are using to resolve them provide a framework for viewing the technological revolution, which will touch every part of American life.

Because of this, technological development should not be left solely to the shortsighted and often narrow-minded management teams. At present, the development of new systems is technology-driven. By that, I mean that the invention of the microchip and the improvements in very large-scale integrated circuits have created tremendous new capacities; and managers and engineers are looking for applications of this technological breakthrough.

The most obvious capacity of the new systems is the ability to store and process vast amounts of information. This ability removes the old limits to centralization at all levels of the organization.

One result of this breakthrough has been that control has moved further and further from the shop floor. Decisions that had in the past been made at the discretion of the individual worker are now being made by managers several levels removed or by computers programed to handle such tasks. This method of operation is called the systems approach.

Studies show that organizing work in this fashion substantially lengthens the time it takes to implement new systems by producing conflicts and resistance among workers. This helps us to explain the outcome of a study which we had performed by a noted economist. The study found that as new technology had been introduced within the Bell System over the years, the effect has been sometimes to decrease unit costs and sometimes to increase unit costs. The net effect over the period we studied, 1947 to 1978, has just about been zero.

Many analysts also feel that it creates inefficiencies in operations because it mystifies the workplace. Our members tell us that what had been a rational and understandable process has suddenly been chopped into several separate and unrelated tasks. Ten years ago, it was easy to find an inside plant technician who was familiar with all the equipment and capable of diagnosing problems and making repairs. But because of the way in which the new technology has been introduced, many technicians are no longer involved with hands-on work. Instead, the problems are identified on a highly automated test desk which directs the worker to replace the faulty piece of equipment, usually a snap-out/snap-in process, requiring very little skill.

As we move further away from the old electromechanical process and as new hires are instructed on only one portion of the overall job, the entire work force is being deskilled. The knowledge and decisionmaking responsibility that once were the property of the worker have been transferred to the memory banks of the computer. The worker is not only discouraged from thinking, but the system is specifically designed to eliminate such efforts.

Two years ago, our development and research department looked at this problem. After careful study, it became clear to us that we must move beyond traditional forms of industrial relations if we are to influence the development of the new technologies and maintain challenging, meaningful work to our current and future members.

We also discovered that the technology that allowed for centralizing control can also be used to decentralize control and upgrade the skill levels of the existing work force. The microchip allows for large amounts of data to flow to the lowest level of organizations. This can provide a picture of the functioning of the entire organization. The individual would then be able to make decisions consistent with the needs of the operation but continue to experiment with more efficient and practical solutions.

We then decided we should take action to maintain and upgrade the skills of our members. The course we decided on was to become involved in cooperative efforts which would allow us to participate in the planning and decisions that affect the work force. To that end, we added some new issues to our bargaining agenda in the 1980 contract negotiations with A.T. & T. The negotiations resulted not only in substantial protection in the traditional areas, but broke new ground in solving the problems created by the changing nature of the workplace.

Three joint committees were established: The Occupational Job Evaluation Committee, Working Conditions and Service Quality Improvement Committee, and Technology Change Committee.

The CWA has participated in the Occupational Job Evaluation Committee because it wants to insure that the workers are compensated for their efforts and responsibilities in the changing nature of work, and it wants to encourage the maintenance of skill levels and responsibilities.

The second joint committee is the Working Conditions and Service Quality Improvement Committee. This committee oversees the quality of work life process which is being implemented throughout the Bell System. This was our response to the job stress created by the new technologies, and basically involves participation in decisionmaking from the lowest organizational level. There are already about 150 participation teams operating throughout the Bell System, and joint training for labor and management is spreading the process further.

The third joint committee is the Technology Change Committee. There is a joint committee in each of our 12 districts and one for sales, installation, and long lines. The contract requires the company to provide the union with at least 6 months' notice of any "* * * major technological changes which may affect employees represented by the union." The committee is further charged with developing recommendations to reduce any adverse impact on employess.

This committee is presently being used to gather information and to serve as an early warning system for anticipated changes. But as we develop our own network of data stewards with expertise on specific technology, it is our hope that we will have a much larger role in influencing how and what new systems will be introduced. We have found a surprising amount of support among company officials. The centralizing of control and information has often left high level supervisors out of the decisionmaking process, even for projects that they are charged with administering. They share our view that much of the equipment is overengineered and needlessly curtails the ability of individual employees to upgrade the system.

The union for which I am a spokesman represents some of the most skilled and productive workers in this country. If this is the way that the new technology treats our members, what would be the impact on the less skilled and less productive?

To meet these problems, I offer several recommendations. Some of these recommendations require legislation, and others can be implemented through collective bargaining.

First, the massive retraining that must occur if the benefits of the new technology are to be shared equally will need government stimulation. If the Government does not wish to participate directly, then it should offer tax subsidies to assure that the retraining goes forward. This could be best achieved by tying the rapid depreciation allowance on new equipment to a demonstration that the existing work force is aptly taken care of, in terms of proper retraining, adequate skill levels, and proper compensation.

Second, once new technology is implemented, workers must receive adequate training to enable them to maintain and improve their skills to work with the technology. Such programs have existed for years in Europe, with great success. Since 1964, West Germany has offered every adult the right to as much as 2 full years of training or retraining. Training costs, an income subsidy which is inversely related to the previous wage, and sometimes even moving and rental costs are all covered. Once this program proved successful, both France and Britain passed similar legislation, and Denmark and Sweden have used this type of program for years.

Third, workers and their union representatives must be assured access to all necessary information on the proposed introduction of new technology. The information must be expressed so ordinary people can understand it. This would include (*a*) a rationale for the technological change, including how it fits in with the organizational values and the economic impact on industrial organizations in the long run; and (*b*) a statement of the human effects of technological change, including the impact on total employment, skill requirements, the shift in the types of employment—technical versus clerical, for example—mental and physical stress, social isolation, working conditions, and health and safety.

Senator, you mentioned the question why did labor provide resistance in the auto industry toward new technology. These are some of the reasons in the short run why they offer resistance to technology.

In the long run, I think that labor sees the importance of technological change because it does reduce costs, it does make more products available, and an improved standard of living for workers. The problem that we have with the technology in the long run is that management and the Government do not let unions and workers participate in decisions on technology. That is the major problem and the reason for the resistance of labor.

There is no avenue for public discussion of how technology affects workers—how it affects present workers, how it affects future workers. That is the resistance that we are here testifying about today.

[The prepared statement of Mr. Straw follows:]

STATEMENT ON "THE IMPLICATION OF THE NEW TECHNOLOGY ON EMPLOYMENT AND TRAINING NEEDS"

PRESENTED BY RONNIE J. STRAW, DIRECTOR
DEVELOPMENT AND RESEARCH DEPARTMENT
FOR GLENN E. WATTS, PRESIDENT
COMMUNICATIONS WORKERS OF AMERICA
BEFORE THE EMPLOYMENT AND PRODUCTIVITY
SUBCOMMITTEE OF THE LABOR
AND HUMAN RESOURCE COMMITTEE:
U.S. SENATE
MARCH 26, 1982

I am Ronnie J. Straw, Director of the Development and Research Department of the Communications Workers of America. We represent over 600,000 workers and administer in excess of 700 contracts in the telecommunications industry. Given the technical nature of the industry in which we organize, we have been able to observe firsthand the effects of new technologies on the work force. I am pleased to have the opportunity to share with you our view on the employment and training implications.

In recent years, many American workers in a variety of jobs have observed firsthand the rapid introduction of new technology into the workplace. New technology can provide a host of benefits to our nation. Decreased costs and improved productivity that result from technological change can supply a much needed boost to our lagging economy. New technology can lead to our improved standard of living, enabling us to enjoy a greater number of improved products and services. Technology can bring us everything from time-saving gadgets for the home to life-saving medical devices and can even prevent the world from running out of energy and natural resources. In the workplace, developments in technology can improve working conditions and open up new jobs.

But our eagerness to reap the benefits of technological change should not blind us from its possible costs. Businesses generally promote new technology in a short-sighted attempt to decrease costs, paying little or no attention to the human effects of innovation. Advancements in technology can have strongly adverse effects on workers by reducing skill requirements, fracturing and eliminating jobs, fostering mental and physical stress, and creating health and safety problems. Workers are heavily monitored and controlled by management - and by machines - causing a dehumanization of the workplace. Employees begin to feel like mere appendages to the machinery, and not like individuals.

These problems are being addressed in the telecommunications industry and are typical of those which will arise as American industry brings the new systems on line. I believe the difficulties that we have encountered, and the methods we are using to resolve them provide a framework for viewing the technological revolution which will touch every part of American life.

At present the development of new systems is technology-driven. By that, I mean that the invention of the microprocessor and the improvements in very large scale integrated circuits have created tremendous new capacities; and managers and engineers are looking for applications of this technological breakthrough.

The most obvious capacity of the new systems is the ability to store and process vast amounts of information. This ability removes the old limits to centralization at all levels of organization. With the assistance of the microprocessor, top management no longer suffers from the difficulties of providing and processing all the necessary information nor from the inefficiencies of transmitting decisions and receiving feedback.

One result of this breakthrough has been that control has moved further and further from the shop floor. Decisions that had in the past been made at the discretion of the individual worker are now being made by managers several levels removed or by computers programmed to handle such tasks.

This method of operation is called the systems approach. The rigid and inhuman logic of the systems approach is made clear in the following statement by Sociologist Robert Boguslaw in an address to a group of systems engineers: "Our immediate concern," he says, "is the exploitation of the operating unit approach to systems design no matter what materials are used. We must take care to prevent this discussion from degenerating into the single-sided analysis of the complex characteristics of one type of systems materials, namely human beings. What we need is an inventory of the manner in which human behavior can be controlled, and a description of some of the instruments which will help us achieve that control. If this provides us with sufficient handles on human materials so that we can think of them as metal parts, electrical power or chemical reactions, then we have succeeded in placing human material on the same footing as any other material and can begin to proceed with our problems of systems design. There are however, many disadvantages in the use of these human operating units. They are somewhat fragile, they are frequently stupid, unreliable and limited in memory capacity. But beyond all this, they sometimes seek to design their own circuitry. This in a material is unforgivable, and any system utilizing them must devise appropriate safeguards."

This statement tells us much about the way in which the new technology is being implemented. It tells us that the human intellect, the most prized of human possessions, is considerably less valued in a system of technical logic. It also tells us that Taylorism, the management technique in which the worker is told exactly what to do and how to do it, is being introduced into the fields of technical and intellectual work. Studies show that organizing work in this fashion substantially lengthens the time it takes to implement new systems by producing conflict and resistance among workers.

This helps to explain the outcome of a study which we had performed by a noted economist. The study found that as new technology has been introduced within the Bell System over the years, the effect has been sometimes to decrease unit costs and sometimes to increase unit costs. The net effect over the period we studied (1947-1978) has been just about zero.

Many analysts also feel that it creates inefficiencies in operations because it mystifies the workplace. Our members tell us that what had been a rational, understandable process, has suddenly been chopped into several separate and unrelated tasks. Ten years ago, it was easy to find an inside plant technician who was familiar with all the equipment and capable of diagnosing problems and making the repairs. But because of the way in which the new technology has been introduced, many technicians are no longer involved with hands-on work. Instead the problems are identified on a highly automated test desk which directs the worker to replace the faulty piece of equipment, usually a snap-out-snap-in process requiring very little skill.

As we move further away from the old electro-mechanical process and as new hires are instructed on only one portion of the overall job, the entire work force is being deskilled. The knowledge and decision-making responsibility that once were the property of the worker have been transferred to the memory banks of the computer. The worker is not only discouraged from thinking, but the system is specifically designed to eliminate such efforts.

This is demonstrated by the evolution of equipment used by the telephone operator. Fifteen years ago most operators used the old cordboard. That is the piece of equipment on which calls came into the central office, were received by the operator, and then plugged into a circuit that carried them to their destination. Although that equipment is still used in some rural parts of our country, it has been largely replaced by the TSPS. TSPS stands for Traffic Service Position System and is the computerized successor to the old cordboard. This system allows for the elimination of local phone offices, paces the flow of calls to the individual operator, catalogues the operator's average work time for each call, predicts the future flow of calls, schedules the operator's breaks and in general welds the operator to the equipment. Combined with scripted responses that the operators are required to provide, this equipment removes all decision-making and human responses from the operator's job.

This development is not necessarily the wish of those creating the new technology, but nonetheless it is occurring. During the taping of a recent television show on technology prepared by CWA, Ian Ross, President of Bell Laboratories, said, "We are being led by the technology at the moment, and I think that we should never lose sight of the fact that technology should be serving people, not people serving technology..." But in spite of his concerns, the technology coming from the labs is creating a rapidly growing number of workers whose productive capacity is spent serving the technology. The reduction in skill levels, the fractionizing of jobs, the downgrading of positions, the reduction in decision making responsibility of employees, the extensive consolidation of work sites, a lack of concern for service to the public and a disregard for the mental and physical stress that the new systems create, are an outgrowth of technical logic forced on the work place because of the availability of these amazing new technologies.

Two years ago, I asked our Development and Research Department to look at these problems. They, with the help of Dr. Michael Maccoby of Harvard University, reviewed all aspects of the situation. After careful study and documentation of the problems and the nature of the evolving technology, it became clear to us that we must move beyond traditional forms of industrial relations if we are to influence the development of the new technologies and maintain challenging, meaningful work for our current and future members. Our studies demonstrated that filing grievances or going to arbitration, after the equipment was in place, would not solve the problems. Also new systems were coming on line so quickly that it was impossible to negotiate work rules that would have any continuing application. We also discovered that the technology that allowed for centralizing control can also be used to decentralize control and upgrade the skill levels of the existing work force. The microprocessor allows for large amounts of data to flow to the lowest level of organizations. This can provide a picture of the functioning of the entire organization. The individual would then be able to make decisions consistent with the needs of the operation but continue to experiment with more efficient and practical solutions.

We then decided we should take action to maintain and upgrade the skills of our members. The course we decided on was to become involved in cooperative efforts which would allow us to participate in the planning and decisions that effect the work force.

To that end, we added some new issues to our bargaining agenda in the 1980 contract negotiations with AT&T, a Company already mindful of the problems. The negotiations resulted not only in substantial protection in the traditional areas, but broke new ground in solving the problems created by the changing nature of the workplace.

Three joint committees were established: The Occupational Job Evaluation Committee, Working Conditions and Service Quality Improvement Committee, and Technology Change Committee.

The CWA has participated in the Occupational Job Evaluation Committee because it wants to insure that the workers are compensated for their efforts in the changing nature of work, and it wants to encourage the maintenance of skill levels and responsibilities. This Committee is charged with developing a plan for the Bell System that produces a hierarchy of jobs acceptable to both parties. This requires agreement on a methodology for documenting work, a set of compensable factors, and a system of scoring jobs. This phase is almost completed and we are now preparing to test the plan in one of the operating companies.

The second Joint Committee is the Working Conditions and Service Quality Improvement Committee. This committee oversees the Quality of Work Life process which is being implemented throughout the Bell System. This was our response to the job stress created by the new technologies, and basically involves participation in decision making from the lowest organizational level. There are already about 150 participation teams operating throughout the Bell System, and joint training for labor and management is spreading the process further.

The third Joint Committee is the Technology Change Committee. There is a joint committee in each of our twelve districts and one for Sales, Installation and Long Lines. The contract requires the Company to provide the Union with at least six months notice of any "...major technological changes (including changes in equipment, organization, or methods of operation) which may affect employees represented by the Union." The Committee is further charged with developing recommendations to reduce any adverse impact on the employees.

This Committee is presently being used to gather information and to serve as an early warning system for anticipated changes. But as we develop our own network of data stewards with expertise on specific technology, it is our hope that we will have a much larger role in influencing how and what new systems will be introduced. We have found a surprising amount of support among Company officials. The centralizing of control and information has often left high level supervisors out of the decision making process, even for projects they are charged with administering. They share our view that much of the equipment is over engineered and needlessly curtails the ability of the individual employee to upgrade the system.

It is the nature of the new technology to change whatever it touches. This is certainly true for labor-management relations. As we secure more information and involvement in systems design it will certainly blur the traditional manager-worker relationship.

But it is our feeling that the risks of such an approach are outweighed by the threat of the continued erosion of skills and jobs.

The lesson of the American auto industry must not be forgotten. When the first Model A rolled off the Ford assembly line, no one could predict the way in which autos would affect our economy and our lives. Likewise, before the oil embargo, no one could predict the sudden collapse of the industry. The hundreds of thousands of unemployed auto workers are equipped to perform few of the jobs in the post-industrial economy. Someday, this new technology that amazes us all, will also be obsolete. With a little planning and foresight the work force need not be. Retraining for existing workers in the latest digital technologies, in the use and repair of microprocessors, and in systems design must begin immediately. The federal government has a responsibility to make that a reality. Since this body has lately felt that these concerns belong in the private sector, then it is your responsibility to make it as financially attractive to do so as you have made it to purchase the new technologies. The rapid depreciation allowances which you passed last year will be hollow legislation if we find that ten or twenty years hence - half the work force is unemployed and half of those working are involved in tasks that can be best performed by those who have taught themselves not to think.

Much has been predicted about the way in which the new equipment will strengthen the economy and improve their country's standard of living. But from our perspective it is difficult to see how this will occur if the technology continues to deskill and displace workers. Because of this we will continue our efforts to increase our participation in decision making at all levels of the companies we organize; we will continue to expand our apprentice programs and the retraining programs that we are experimenting with, and we will continue to raise the issues that we have raised here today.

The Union for which I am spokesman, represents some of the most skilled and productive workers in this country. If this is the way that the new technology treats our members, what will be the impact on the less skilled and less productive?

To meet these problems I offer several recommendations. Some of these recommendations require legislation and others can be implemented through collective bargaining.

1) The massive retraining that must occur if the benefits of the new technology are to be shared equally will need government stimulation. If the government does not wish to participate directly then it should offer tax subsidies to assure that the retraining goes forward. This could be best achieved by tying the rapid depreciation allowance on new equipment to a demonstration of those applying, that the existing work force has not been deskilled or displaced by the new equipment.

Once new technology is implemented, workers must receive adequate training to enable them to maintain and improve their skills to work with new technology. Such programs have existed for years in Europe, with great success. Since 1964, West Germany has offered every adult the right to as much as two full years of training or retraining. Training costs, an income subsidy which is inversely related to the previous wage and sometimes even moving and rental costs are all covered. Once this program proved successful, both France and Britain passed similar legislation, and Denmark and Sweden have used this type of program for years.

2) Vocational Technical Schools should update their curricula to assure that they are preparing students who can interact with, and not just tend the new technologies.

An example in our industry would be the technician assigned to a multi-loop Tester (MLT). Recent Vo-Tech graduates who are assigned to this position are only equipped to respond to the limited options that the computer provides. Training in systems design and computer software, would prepare them to understand more than just their assigned task, equip them to deal with emergency situations resulting from technical failures, and enable them to interact with the automated equipment in efforts to upgrade the system.

3) Public education at the primary and secondary levels must be more active in preparing students to deal with the new technology. A recent survey suggested that although computer terminals are not rare in primary schools, they are present much more frequently in well to do school districts than are in poor districts. If this trend continues it will have predictable results as the students enter the labor force.

4) Workers and their Union representatives must be assured access to all necessary information on the proposed introduction of new technology. This would include:

a) A rationale for the technological change, including how it fits in with organizational values and the economic impact on industrial organization in the long run.

b) A statement of the human effects of technological change, including the impact on total employment, skill requirements, the shift in the types of employment (technical vs. clerical, for example), mental and physical stress, social isolation, working conditions, and health and safety.

5) Finally, the Administration should maintain an economic policy to promote full employment, an equitable income distribution and strong economic growth. (See attached policy statement). The rapid implementation of new technologies without any thought of the impact on the existing work force will not solve our economic problems. Our best course of action is to use properly our greatest natural resource - labor.

Senator **Quayle**. Thank you, Mr. Straw. I wonder if I might just ask a question on the resistance or the perceived resistance. I wonder if the tradeoff might be on the introduction of new technology, whether it is robots or whatever it may be—if the tradeoff that management would have to make would be job security to the people that are employed right now. If they will guarantee that nobody is going to lose their job, then would their resistance be cut down? I think that is paramount. I said to the auto people, "You cannot just threaten to lay off 100,000 people at will." I mean, you are going to get resistance, and you should, but if you can get that job security—and this is what Japan has. They have basically lifetime job guarantees, once they get a permanent job there. Wouldn't this be a fair tradeoff?

Mr. **Straw**. Well, I think that is a very reasonable trade-off, but that is only one aspect of how technology affects workers. And you have to think about future workers, as well. For example, workers are deskilled, and there is no money for retraining. And some of the jobs that are created are very boring and monotonous jobs and require extreme mental discipline. But these are things that have to be considered.

In Japan, for example, you say that this has been the trade-off, lifetime employment, and I think that has been true. But just the other day, I met with a Japanese delegation. They told me that they do guarantee life employment to a lot of the male workers, but in addition to that, they expand the skills of the existing workers, and also the future workers. They do this by rotating jobs so that the workers can expand their knowledge of the industry and transfer these skills within their jobs. They just do not keep deskilling them and de-skilling them, as we do in this country.

Senator **Quayle**. "De-skilling" them?

Mr. **Straw**. De-skilling them; robbing workers of their skills. You see, the only thing that a worker has is the job that he does. And what you are doing when you introduce this technology and do not give him additional skills is you rob him of his job, of his skills. That is what you do.

Senator **Quayle**. So with the introduction of this new technology, not only do you need the job security, but you need a definite plan that is going to show the enhancement of one's skills and the utilization of the human labor initiatives that are so latent in all of our people, both men and women, who are in the work force?

Mr. **Straw**. Absolutely.

Senator **Quayle**. I can see it—and if that is not coming through, it probably should. But it seems to me we are in a huge transition. You talk about retraining, we have a program to try to retrain them, and for the first time, we have a special section, title V, that is going to deal with the displaced worker. Well, no one ever before has talked about the displaced worker for a job training bill. And myself and Senator Kennedy have gotten together and promoted this legislation and focused on the displaced worker. I mean, we are in a real transition. There is going to have to be some understanding, and the last gentleman mentioned this, some sort of a national institute or organization that is going to take involvement as we see this change in our society. He talked about the social contract and all the changes, and we are going to have to keep talking about it, because it is something that we have to deal with. I have to look at it from employment. I want to see employment, I want to see jobs, and I want to see quality of life improve for not only the people of Indiana, but around the whole country. You have got a certain commitment to the people you represent now and also future generations. And this is the reason we are having these hearings. We do have to have this spirit of partnership, and coming together, and how we get there is certainly open to discussion.

Mr. STRAW. I think the hearings are very important, in terms of getting out this discussion. But really, what we are interested in is to have the right to participate in the decisions about technology as put on the line—and this is not very complex; in fact, it is very simple. All management has to do is say, "Here is what we want to do. What do you think?" What is going to be the impact. You know, workers are quite capable of telling management how particular technology affects the work and their jobs.

In our productivity example, I mentioned this. From the period 1947 to 1977, the introduction of technology in the Bell System had zero impact, and a tremendous amount of technology was introduced. In terms of reducing cost, it had zero impact.

Senator QUAYLE. Yes, but they certainly expanded their services and things like that. I mean, the unit cost may not have changed, but certainly, the services and everything expanded.

Mr. STRAW. Their services did expand, yes. But what we are seeing in our studies, the impact of technology is zero.

Senator QUAYLE. And you are talking about unit cost, just the unit cost?

Mr. STRAW. Yes, I am talking about unit cost, that is right.

Senator QUAYLE. But I am sure that their growth, if they had not had some of that technological——

Mr. STRAW. Their costs went down because of economies of scale. But what I am trying to drive at, the reason that the technology that went on the lines was zero over this period of years was because they never consulted anyone. There were worker morale problems when they introduced the technology. People were not trained properly. The technology was not put on the line right. Had it been put on right, the unit cost would have been reduced, and this is one of our complaints, too, because we depend upon lower costs and higher profits to get our wage increases.

Senator QUAYLE. Believe me, you are not going to get any argument out of me that the lack of communication between management and labor is one of the reasons we find ourselves in a low productivity area right now. I think, quite frankly, that is one of the keys. So you are not going to get an argument——

Mr. STRAW. Well, we believe in the free collective bargaining system, and it would be good if the Federal Government endorsed some type of national policy saying that technology is a major concern and should be in the arena of public debate.

My fifth point is that the administration should maintain an economic policy to promote full employment and equitable income distribution, and strong economic growth. The rapid implementation of new technologies without any thought of the impact on the existing work force will not solve our economic problems. Our best course of action is to use properly our greatest natural resource, labor.

I thank you very much, Senator, for allowing us to appear before your committee. I would like to place in the record a copy of our productivity study, which was done about a year ago, and also, our economic statement which was presented to our convention in Boston.

Senator **QUAYLE**. Both of those documents will be placed in the record in full.

Mr. **STRAW**. Thank you very much.

[The productivity study and the economic statement referred to follows:]

EXECUTIVE REPORT

Simplications for the Communications Workers of America of Technological Change at the Bell System

PETER CHINLOY

May 1981

Submitted under contract to:

R. J. Straw
Director, Research and Education
Communications Workers of America

For internal use at the Communications Workers of America

1. PRODUCTIVITY CHANGE

1.1 Introduction

The objective of the study has been to assess the effect of technological change on the level of employment at the Bell System. In addition, the contribution made by labor to that change is examined. The results obtained indicate that the technological change arising at the Bell System does not occur independently of the labor, materials and capital used by the firm.

Also, there are two alternative measures of productivity change to be applied. They are examined spearately, and results reported on. The first is based on total factor productivity, or an index of outputs divided by another index of all inputs. As an example, the inputs contain not only labor of various categories, but also capital, energy and raw materials. The second is based on labor productivity, corresponding to measures presented and published by the Bureau of Labor Statistics. In this section, the two alternative measures are explained and developed, and estimates presented for the Bell System 1947-1978.

1.2 Total factor productivity

The Bell System, for the classification in this study, produces three categories of output. These are local and interstate services and other outputs. The other outputs include intrastate and international services, rental of property, computer facilities and data transmission. To construct a measure of productivity, it is necessary to combine the three definitions of output. The procedures of construction of output are described in the technical report.

Before deriving a single measure of output, it is instructive to examine the output performance of the Bell System. This is presented in Table 1, for the three types of service. The prevailing trend over the 1947-1978 period is for local service to grow at a slower rate than interstate and other services. The Bell System is shifting is output composition rapidly from being a provider of local telephone service to a data transmission and general communications supplier.

The measure of total factor productivity requires that these output be combined, and divided by some combination of inputs. Hence, the relation is:

Total Factor Productivity = Output index/Input index.

Suppose we have the following information

	Year 1	Year 2
Output index	100	110
Input index	100	105

Then total factor productivity would show a value of 100 in year 1 and 110/105 in year 2, or 104.8. This indicates a total factor productivity growth rate of 4.8 per cent over the year. Productivity increases also reduce the cost of production. Another method for measuring total factor productivity is by examining costs. If costs decline, after taking account of all measured changes in inputs and outputs, then productivity growth is said to occur.

In order to calculate these measures, series on the inputs used by the Bell System are constructed. There are four inputs, namely total hours weighted by relative earnings, capital, raw materials and electricity. These four are indicated in Table 2. It is observed that for labor, there has been a relatively steady growth of employment. The weighted index increased by 2.2 per cent per

Table 1. Cost Elasticity, Output and Capital Growth, Bell System 1947-1978

Year	Cost Elasticity	Output Growth	Capital Growth
1947-48	0.54216	0.10943	0.14489
1948-49	0.54749	0.05075	0.08749
1949-50	0.55243	0.07407	0.07544
1950-51	0.55726	0.08705	0.08797
1951-52	0.56438	0.06923	0.04482
1952-53	0.56973	0.05107	0.08561
1953-54	0.57424	0.05177	0.06803
1954-55	0.58350	0.09060	0.08238
1955-56	0.58786	0.08663	0.09828
1956-57	0.59680	0.06975	0.08928
1957-58	0.59828	0.04863	0.06712
1958-59	0.60886	0.08143	0.05182
1959-60	0.61685	0.08331	0.05373
1960-61	0.62202	0.04485	0.05465
1961-62	0.62856	0.06503	0.05904
1962-63	0.63497	0.06594	0.06726
1963-64	0.64359	0.07468	0.06971
1964-65	0.65197	0.08437	0.07621
1965-66	0.66011	0.09707	0.08823
1966-67	0.66699	0.07441	0.09739
1967-68	0.67431	0.08458	0.09544
1968-69	0.68505	0.09659	0.11279
1969-70	0.69271	0.06793	0.13380
1970-71	0.69921	0.05267	0.13352
1971-72	0.71109	0.06247	0.10846
1972-73	0.71630	0.04352	0.11691
1973-74	0.72503	0.12403	0.14783
1974-75	0.73020	0.05233	0.12043
1975-76	0.74020	0.07190	0.09502
1976-77	0.74625	0.07894	0.08194
1977-78	0.75405	0.09284	0.07422

Table 2. Input Growth Rates for Materials, Electricity and Fuel, and Labor.
Bell System, 1947-1978.

Year	Materials	Electricity / Fuel	Labor
1947-48	12.305	-3.193	4.540
1948-49	5.625	11.680	1.958
1949-50	2.521	1.756	0.171
1950-51	4.834	3.235	4.807
1951-52	9.559	9.746	5.029
1952-53	2.865	5.776	4.309
1953-54	9.593	9.429	0.842
1954-55	9.028	6.588	0.079
1955-56	10.163	5.579	7.776
1956-57	-0.426	5.366	-3.010
1957-58	-4.758	13.460	-0.119
1958-59	7.927	7.523	-4.071
1959-60	6.838	6.098	0.068
1960-61	7.901	4.950	-0.700
1961-62	3.293	9.140	0.633
1962-63	8.219	6.440	0.146
1963-64	5.817	8.967	3.317
1964-65	8.807	6.463	3.358
1965-66	5.577	2.341	4.040
1966-67	2.576	4.645	1.752
1967-68	0.212	8.018	1.615
1968-69	15.372	6.235	5.316
1969-70	8.696	3.759	5.083
1970-71	5.386	8.138	1.025
1971-72	4.960	9.970	0.209
1972-73	5.326	-0.765	2.473
1973-74	2.535	-18.209	0.845
1974-75	1.224	2.128	-0.143
1975-76	10.501	-0.991	-0.778
1976-77	7.812	-1.496	4.482
1977-78	8.291	-0.999	4.701

year over 1967-1978. For 1947-1967, labor input at Bell increased by 1.7 per cent annually.

An index of the four inputs and three outputs, together with total factor productivity, is indicated in Table 3. The index indicates growth in the output per input used for the Bell System greater than that for the U.S. private domestic economy as a whole.

The development of total factor productivity measures in this study take account of the fact that the Bell System may not be a competitive firm. Also, the use of either costs or outputs yield the same information.

1.3 Labor Productivity

Another method of constructing productivity estimates is on the basis of labor. Labor productivity is the amount of output produced per unit of labor input. Labor input is total hours worked multiplied by a measure of the skills performed in each hour. Conceptually, total factor productivity indicates the average output obtained from all of the inputs used by the firm. However, labor productivity is as important a concept, indicating the amount of output producible by the average hour, corrected for skill. There is a relation between these two productivity measures, and either can appropriately be used.

The measure of total output used is the same in both methods. For the purposes of our study, the output measure used includes the effects of the regulation on rates of return on output. For the inputs, the index of growth rates is constructed as the weighted average, with the weights being the percentage each constitutes of the total variable cost to the firm. In the case of the Bell System, labor costs are approximately 75% of all operating costs.

Table 3. Input Cost Shares
Bell System 1947-1978.

Year	Materials	Electricity / Fuel	Labor
1947-48	0.19061	0.00646	0.80293
1948-49	0.19319	0.00656	0.80024
1949-50	0.19617	0.00655	0.79728
1950-51	0.20268	0.00660	0.79071
1951-52	0.20709	0.00662	0.78629
1952-53	0.20790	0.00663	0.78547
1953-54	0.20923	0.00664	0.78413
1954-55	0.21100	0.00662	0.78238
1955-56	0.21590	0.00668	0.77743
1956-57	0.21917	0.00676	0.77407
1957-58	0.22144	0.00676	0.77179
1958-59	0.22350	0.00672	0.76978
1959-60	0.22346	0.00672	0.76982
1960-61	0.22441	0.00674	0.76885
1961-62	0.22491	0.00674	0.76835
1962-63	0.22631	0.00673	0.76696
1963-64	0.22697	0.00669	0.76634
1964-65	0.22767	0.00668	0.76566
1965-66	0.23065	0.00673	0.76262
1966-67	0.23393	0.00678	0.75928
1967-68	0.23682	0.00678	0.75639
1968-69	0.23867	0.00675	0.75458
1969-70	0.23874	0.00675	0.75451
1970-71	0.23820	0.00680	0.75500
1971-72	0.23390	0.00680	0.75930
1972-73	0.22976	0.00684	0.76340
1973-74	0.23299	0.00735	0.75966
1974-75	0.23701	0.00788	0.75511
1975-76	0.23591	0.00800	0.75610
1976-77	0.23645	0.00813	0.75542
1977-78	0.24058	0.00828	0.75114

The relation between labor productivity growth and total factor productivity growth can be calculated from the following. Suppose the information arising is:

Output growth	:	0.05 (5 per cent)
Labor input growth	:	0.02 (2 per cent)
Other input growth	:	0.03 (3 per cent)
Labor share of costs	:	0.75 (75 per cent of costs are labor costs).
Other input share of costs	:	0.25 (25 per cent of costs are for other inputs).

The growth of all inputs is then (0.75 x 0.02) + (0.25 x 0.03) or 0.015 + 0.0075 = 2.25 per cent per year. The contribution of labor to this growth is 1.5 per cent per year, or the growth of labor input multiplied by its share of costs. The measure of total factor productivity growth is 0.05 - 0.0225 or 0.0275 or 2.75 per cent per year. Of all the 5 per cent growth, the contribution of labor is 1.5 per cent, or 30 per cent of the total.

Labor productivity changes at a rate of the difference between output growth and labor input growth, or 3 per cent per year. The relation between the two measures is obtained as follows. Output growth can be analyzed in the accounting table

Output growth		0.05
= (Labor input growth x Labor share of costs) (0.02 x 0.75)	=	0.1500
+ (other input growth x share of costs) (0.03 x 0.25)	=	0.0075
+ Total factor productivity	=	0.0275
	=	0.05

now substract labor input growth from both sides of this accounting table

Output growth - labor input growth = labor productivity growth	= 0.05 - 0.02	= 0.03
= Other input growth x share of costs	0.03 - 0.25	0.0075
+ Total factor productivity		0.0275
+ Labor input growth x (share of costs - 1.00)	0.02 x -0.25	- 0.0050
		0.03

so the two measures of productivity are related. Consequently, either is a measure of performance.

Moreover, labor productivity is related to the movement of real wages facing the company. This is wages deflated not by a general Consumer Price Index but by the costs of operation for the company. These are indicated in Table 4. In an equilibrium case, the growth of labor productivity is equal to the growth of real wages. Another way of expressing this is that the ability to finance real wage increases is at the growth of labor productivity.

Clearly, the productivity issue facing the Bell System is critical. The conclusions from this analysis are summarized:

a. Output has continued to grow rapidly at the Bell System, with a shift from local service to long lines and other transmissions.

b. Labor input has grown at a rate slower than that of output. This means that labor productivity has increased steadily at Bell. Since real wages can be increased at the rate of growth of labor productivity without harm to the company.

Table 4. Technical Change and Labor Productivity, Bell System 1947-1978. (In Percent)

Year	Technical Change	Technical Change - Labor Normalization
1947-48	-0.90937	0.52080
1948-49	-0.42016	0.35208
1949-50	2.69094	3.16230
1950-51	-0.92673	-0.93154
1951-52	-2.95796	-1.98862
1952-53	-1.80752	-2.09807
1953-54	-0.51411	1.37368
1954-55	1.80499	3.73631
1955-56	-4.68753	-4.18676
1956-57	5.23049	5.85338
1957-58	3.01150	2.07607
1958-59	4.53962	7.29910
1959-60	1.60443	3.15795
1960-61	0.43928	2.40749
1961-62	1.14864	1.80434
1962-63	0.41266	2.28195
1963-64	-1.22888	-0.62371
1964-65	-1.64786	-0.38654
1965-66	-1.04452	-0.70138
1966-67	0.53890	0.75112
1967-68	1.45959	1.17095
1968-69	-4.62820	-2.22187
1969-70	-3.82287	-2.96903
1970-71	-0.51030	0.57690
1971-72	0.45548	1.63314
1972-73	-1.86040	-1.22698
1973-74	2.36634	2.62013
1974-75	1.22644	1.56844
1975-76	0.02277	2.68192
1976-77	-3.19349	-2.45470
1977-78	-3.19756	-2.38111

c. The rate of labor input growth has averaged 2.2 per cent per year, and its share of operating costs is 75 per cent. So the contribution of labor to output growth annually is 1.65 per cent per year.

d. Labor productivity and total factor productivity are related, and either can be used to measure the performance of the Bell System.

2. Labor and substitution

An issue for labor and the Communications Workers of America is the degree of substitutability between labor and other factors of production. As a specific example, there have been substantial increases in the price of energy relative to other commodities in the 1970's.

The increase in energy prices particularly affects the Bell System in the area of electricity. Electricity is the most important energy component. In the course of this research study, the effect of substitution between energy, raw materials and labor is examined. Capital-labor substitution is not examined directly, for capital is fixed in the short run. It should be noted that throughout the study labor is taken to mean all employees of the Bell System including both unionized and non-unionized personnel.

In general, the overall substitution possibilities are low. If labor is a substitute for energy, then as energy prices increase, there will be a tendency for increased long-run employment. We find:

- it is possible to examine the overall substitution possibilities between raw materials, energy and labor. These possibilities are relatively limited.
- the results indicate that increases in relative energy prices are not the cause of the long-run slow rise in employment.

- increases in wage rates will not cause great substitution of energy and raw materials for labor. The effect for capital and labor is unsettled.

3. Employment opportunities

An important aspect of wage bargaining is the effect of wage increases on long term labor demand. It is known that the quantity of labor demanded decreases when wages increase and the other factors affecting employment are held constant. Any policy implications in the area of employment opportunities should be interpreted cautiously, because of the inability of the data made available by the Bell System to distinguish between unionized and non-unionized workers. Partial information on total compensation and total employment of Communications Workers of America members was available, but only for some years 1947-1978. So any conclusions drawn apply to all Bell employees as a whole, and not only the unionized membership.

Estimates of the effect of rising wages on employment opportunities are constructed by measuring the percentage fall in labor demand when wages rise by one percentage point. If this percentage fall is less than one percentage point, increases in wages will increase total payroll. This observation does arise from the study of the Bell System.

4. Employment composition shifts

The shift in employment composition at the Bell System has been gradual, but generally against unionized members and in favor of non-unionized members. This is indicated in Table 5. Total hours worked for each category of labor is illustrated. No corresponding series on wages is available on an annual basis.

Table 5. Labor Input, Unweighted Employee Hours, Bell System 1947-1978.

	Telephone Operators (1)	Technicians (2)	Office Duties (3)	Other Non-Supervisory (4)	Supervisors (5)	Executive and Staff (6)	Total Unweighted Employee Hours (7)
1947	402.1	131.2	130.0	66.2	58.9	37.3	825.7
1948	406.3	141.3	138.5	69.1	64.2	39.8	859.2
1949	381.1	151.0	144.8	69.0	67.4	42.6	855.9
1950	355.7	152.2	144.1	67.3	72.2	43.3	834.8
1951	382.1	156.1	150.1	71.4	72.0	45.9	877.6
1952	393.5	160.8	161.3	75.8	76.6	50.4	918.4
1953	392.4	167.7	170.7	78.4	83.0	55.1	947.3
1954	370.2	175.1	176.1	80.3	83.6	56.4	941.7
1955	356.9	181.2	176.2	80.2	84.8	57.8	937.1
1956	373.8	204.7	192.2	88.1	91.1	65.2	1,015.1
1957	356.5	192.2	191.6	88.5	89.1	65.5	983.4
1958	327.2	192.8	185.4	89.3	93.7	68.5	956.9
1959	300.1	188.8	170.7	86.4	89.0	65.4	900.4
1960	289.9	190.4	170.9	88.1	87.6	66.9	893.8
1961	269.2	189.5	169.9	90.3	84.0	74.0	877.0
1962	263.3	193.9	169.1	90.9	81.0	78.3	876.5
1963	257.3	195.2	165.1	90.8	79.2	83.8	871.4
1964	265.0	204.6	165.1	92.5	78.5	94.1	899.8
1965	272.7	215.7	171.2	94.8	83.2	98.7	936.3
1966	286.6	227.1	178.1	98.4	88.3	104.6	983.1
1967	284.2	232.0	182.7	101.1	92.3	108.8	1,001.1
1968	285.1	240.1	185.6	103.6	95.2	109.9	1,019.5
1969	295.6	264.9	199.6	112.6	101.1	113.2	1,087.0
1970	302.6	282.9	210.2	118.9	108.8	123.6	1,147.0
1971	278.2	291.2	208.7	120.0	114.0	131.2	1,143.3
1972	256.6	290.3	201.3	120.4	118.0	136.9	1,123.5
1973	252.5	309.7	201.5	124.8	117.5	137.4	1,143.4
1974	241.7	310.4	202.1	135.1	121.3	133.5	1,144.1
1975	218.3	306.5	192.8	137.1	128.4	131.8	1,114.9
1976	196.6	283.0	186.3	163.7	112.3	142.2	1,084.3
1977	182.8	250.9	190.6	189.8	118.0	174.6	1,106.6
1978	177.1	270.5	181.9	213.7	120.2	190.8	1,154.2

The occupational distribution in Table 5 shows the trends. Executives and staff worked 37.3 million hours in 1947, or 4.5 per cent of the total. In 1978, this had increased to 1.154.2 million, or 16.5 per cent. In examining labor quality, or the skills provided per hour of work, wages of both groups can be examined.

The study reveals a rapid transformation of the Bell System work force. We find:

- a sharp decline in total hours worked by telephone operators, from 402.1 million in 1947 to 177.1 million in 1978.
- a decline also in workers engaged in office duties, such as secretarial staff. Total hours increased from 130.0 million in 1947 to a maximum level of 210.2 million in 1970, but declined to 181.9 million in 1978.
- a rapid increase in the categories of supervisor and executive and staff. Supervisory employment increased from 58.9 million hours in 1947 to 120.2 million in 1978.

The results also suggest that within the unionized category, there is a compositional shift towards technicians and away from telephone operators. This may require a shift in organizing priorities.

5. Returns to scale

Tests of returns to scale are carried out for the Bell System as a whole. The basic result is that returns to scale in general are present in the Bell System. This conclusion proves not to be senstitive to the choice of aggregation.

For example, these increasing returns to scale hold for one output, or for three outputs.

In determining the areas of Bell System operation where increasing returns obtain, the three output categories of local service, interstate service and other services were again distinguished. Overall returns to scale obtain if costs increase at a slower percentage rate than output. The conclusion is that the long lines interstate facility possesses the greatest returns to scale. Returns to scale are also present in local service but these have been declining in importance in the 1970's. In other services, containing directory advertising, intrastate and international service, there is no evidence of increasing returns.

STATEMENT ON ECONOMIC POLICY TO THE 43RD ANNUAL CONVENTION

Our nation has entered the decade of the eighties with renewed hope for the years ahead. Americans optimistically view the future with its promises of growth, prosperity and a better life for all. President Reagan began his term in office on the strength of this new hope, calling his policy for economic recovery, "America's New Beginning."

The Communications Workers of America applauds the sincerity and good intentions of any new attempt to put our nation back on course to a healthy, growing economy, for a new beginning is sorely needed. Yet we caution against ill-conceived, inequitable strategies that seek to make the economy look good in the accounting books but give little thought to the well-being of the millions of working men and women in this country who make our economy function. Equity and fairness must not be sacrificed in the name of higher production. To do so would be to disclaim the democratic foundations of our entire economic and social system.

American workers have long suffered the burden of an ailing economy. It is the workers who bear the heaviest burden of our economic distress, not the corporations with their record profits or the wealthy who benefit from windfall capital gains. As we begin our passage through the 1980's, American families once again find themselves riding atop the dismal economic wave of the seventies. Inflation is still in the double-digit range and unorganized workers find their wages are not keeping pace with prices. As real wages drop, the standard of living continues to fall as is all too often the case, the burden falls heaviest on those who can least afford it. Families plunge more deeply into debt as they try to make ends meet. High interest rates dash hopes of homeownership for many families and preclude others from obtaining an education for their children. Many of the poor and elderly who live on fixed incomes must even forego adequate food, a warm home in winter or much needed medical care because they just cannot afford it.

But inflation is only a secondary problem for the nearly eight million Americans who are counted among the unemployed. An estimated three million more - which brings the unemployment count to 11 million - are out of work but not part of the official unemployment tally. These men and women have become discouraged and dropped out of the labor force and thus are no longer considered "unemployed" by the federal government. These are the people who would benefit most from renewed economic vitality, and who suffer most from economic disorder.

The Past Year - No Relief in Sight

In the past year, inflation-related issues have not changed in scope from previous years as prices continue their upward spiral. Inflation is maintaining its double-digit levels, with necessary items, energy, food, housing and medical care, registering the greatest increases in the Consumer Price Index (CPI).

The necessities index, comprising about 70 percent of an average American's budget, has been advancing at greater rates than the overall CPI in the past decade. The consequence is that a larger share of the family's budget must be used to pay for necessities rather than luxuries, leading to a decline in the family's standard of living. This predicament is especially difficult for those at lower income levels who are forced to spend a greater share of their incomes on necessities.

At the close of 1980 the overall CPI had increased 12.5 percent over the previous year, which was lower than the 13.4 percent inflation rate in 1979. Based on first quarter data, the compounded annual inflation rate is projected to increase 9.6 percent over last year. However, economists project inflation to maintain its double digit rate through 1981 with an overall increase of 11.5 percent in the Consumer Price Index.

The following table shows quarterly and annual increases in the Consumer Price Index (CPI-W) in 1980

INFLATION RATES 1980-81*
(Consumer Price Index)

1980	All Items	Food	Energy (Fuel)	Housing	Medical Care	Transportation
1st Qtr.	18.1%	4.3%	31.5%	19.3%	15.3%	34.9%
2nd Qtr.	11.4	6.6	20.4	20.1	9.4	2.8
3rd Qtr.	8.2	19.2	11.1	1.5	9.6	10.6
4th Qtr.	13.2	13.3	8.6	16.3	8.0	14.8
Year (Dec. 1979-Dec. 1980)	12.5	10.5	16.9	13.8	10.3	14.7
1981						
1st Qtr.	9.4	1.7	33.3	7.1	13.1	22.7

* Quarterly figures are seasonally adjusted annual rates.

In analyzing the necessities index, the chief factor contributing to its growth has been energy price hikes. Since the beginning of 1981, energy prices have risen much more rapidly than other items in the index. The increase was a dual reaction to a price hike by OPEC in December and deregulation of domestic oil prices by President Reagan after he took office in late January. Energy (fuel) prices rose 33.3 percent at a seasonally adjusted annual rate in the first quarter of 1981.

Oil prices are expected to remain stable throughout the rest of 1981 due to an oil glut, utilization of alternative energy sources and continuing fuel conservation. The other categories in the necessities index show slower upward movement in comparison.

Transportation costs, which include public and private transportation and gasoline rose at an annual rate of 22.7 percent in the beginning of 1981.

Food prices remained stable, rising at 1.7 percent annually during the first quarter, with meat, fish, poultry, and eggs experiencing the largest decreases while fruit and vegetable prices increased rapidly. The freeze in Florida contributed to some of those higher prices.

Finally, medical care costs have increased more rapidly, at an annual rate of 13.1 percent, in 1981 than the 1980 average of 10.3 percent. The three chief contributors to the increase were hospital rooms, physician's fees and medical care commodities.

Housing costs went up 13.8 percent during 1980 and are rising at an annual rate of 7.1 percent in 1981. High and volatile interests rates are a key component of rising housing costs. Interest rates climbed to 20 percent in March 1980, fell to 11 percent in August and peaked at 21.5 percent at the end of the year. Interest rates then fell a bit in early 1981 but are again on the upswing.

The only relief in sight is to see great improvements in productivity growth. Productivity increased at all levels in the first quarter of 1981, registering a gain of 4.3 percent in the private business sector after a 1.2 percent decline in the fourth quarter of 1980. Since January, output and hours of work have both increased while unit labor costs have increased at their lowest rate since the second quarter of 1978. Nonlabor payments, such as taxes, depreciation, net interest and profits also increased at a slower rate.

Unemployment jumped to 7.6 percent or 8.2 million jobless in May after holding steady at 7.3 percent throughout the first quarter of 1981. This increase followed a slow but stable decline in the unemployment rate after it last peaked at 7.6 percent in October.

The greatest increase in the unemployment rate was felt by construction workers who have been faced by steadily declining employment in the construction industry since January. Also affected by the rise in the unemployment rate were adult men, Whites and Hispanics. Blacks and teenagers are still continuing to suffer from double-digit unemployment rates. In fact, the 13.6 percent unemployment rate for Blacks is double that for White workers.

During 1980 the unemployment rate increased sharply as the number of jobless reached almost 8 million. This level showed little improvement in the second half of 1980 and has only declined a negligible amount so far this year. It is interesting to note that men who predominate in those industries where job cutbacks were most extensive absorbed a major proportion of the increases. The impact was so extensive that by the end of the third quarter their rate exceeded that for adult women, a highly unsual labor market occurrence.

The only relief in sight for improving high unemployment levels is a healthy economy. Neither business nor government are interested in helping the unemployed when the economy is unhealthy. They pay lip service to the jobless and press for cuts in unemployment benefits and tougher eligibility requirements.

Full economic recovery is a long way from the Administration's projections. Inflation and unemployment have only improved slightly over the past several months and Gross National Product is not growing as quickly this year as it did at the end of 1980.

Other factors which will impact on the recovery will be the effect of the President's budget and tax cuts. Since there is no evidence whether or not supply-side economics accomplishes what its supporters pronounce it will, the outcome is imperceptible and the rest of 1981 shows very little relief.

America's New Beginning - But For Better or Worse?

The Reagan Administration has embarked on a new course to end our economic woes. The new policies seek to combat inflation and increase economic growth by dramatically slashing government spending for domestic programs, eliminating many federal regulations and enacting a series of tax cuts for individuals and corporations. The goals of low inflation and strong growth are certainly laudable, but the strategy proposed by the Administration lacks three criteria necessary to achieve the desired outcome: it is inequitable, narrow in scope and in many ways devoid of sound economic judgment. Not only do the means of this policy not justify the ends, but it is highly uncertain whether those goals will ever be attained via the proposed strategy.

The Reagan economic recovery plan entails the following:

1) The Budget
    - Major cutbacks in non-defense spending starting with the elimination of $48 billion in fiscal 1984 when compared to the Carter budget proposed in January 1981.
    - The Administration claims it is preserving a "social safety net" to protect elderly and low income citizens. Yet it is apparent that this net is filled with holes.
    - Most of the cuts come in the areas of needed social, health and educational programs which the Reagan camp has labeled as "low priority," "unintended" or "non-essential." For example, some of the federal programs

being cut back or eliminated are black lung benefits for miners, medicaid, food stamps, trade adjustment assistance for displaced workers, low-income housing assistance, extended unemployment benefits, low-income energy assistance, student loans, school lunch subsidies and CETA jobs. These programs were by no means "unintended." They have been developed over the past 35 years since World War II as we became aware of areas of neglect in our economy. No dollar savings recorded in the national income accounting books will help the millions who depend on and truly need these programs.

- Close to 100 categorical grants for health, education and social services will be merged into block grants for state and local governments in an effort to reduce administrative overhead and paperwork. This will also give more discretionary authority to the states in the allocation of such services. The problem with this proposal is that there is no way to ensure that the block grants are directed to the specific people or localities that are most in need of these social services.
- The Administration also proposed a cutback in the social security program. Current recipients would suffer a three month lag in their cost-of-living increases, but benefits would be lower for future social security beneficiaries. Disability payments would be cut and most eligibility requirements tightened. Also, minimum payments would be eliminated. In general, we will all have to work longer to get smaller payments. The proposal does have

some merit, however: the earnings restriction (which deducts one dollar from the monthly payment for every two dollars earned over a certain amount) will gradually be eliminated and the payroll tax will be reduced.

- Federal credit in the form of grants, loans and guarantees will be greatly limited, reducing the federal credit budget by $13.6 billion in 1981 and by $21.0 billion in 1982. Credit reductions will be made in the areas of agricultural credit for farms, rural housing and emergency disasters, rural electrical and telephone cooperatives, economic development for distressed areas, biomass and geothermal energy subsidies, federal housing mortgage insurance, consumer cooperatives and student loans. These programs not only provide affordable credit to needy individuals and communities, they also serve as a counterweight to private sector interest rates that are already too high.
- Defense spending is the only portion of the budget that will be expanded, growing at an annual rate of nine percent in real terms by 1986. This represents a major policy shift toward a defense budget.
- Total federal spending is expected to be 19 percent of Gross National Product (GNP) by 1986, down from 23 percent in 1981.

- The Administration claims that the federal budget is expected to be balanced by fiscal 1984, with spending equal to receipts at approximately $770 billion, or or 19.3 percent of GNP. However, the outcome of a balanced budget is unlikely because the Administration's forecasts are based on unrealistically low assumptions for inflation and unemployment rates.

2) Tax Policy

- Personal income tax rates will be reduced by 25 percent over three years beginning in 1981.
- The "marriage penalty" will be reduced by allowing the lesser earning spouse to deduct 15 percent of income up to $3,000 by 1983.
- The estate tax exclusion will be raised from $175,000 to $600,000, with no limit for estates passed on to surviving spouses. The limit on tax free gifts will be raised from $3,000 to $10,000.
- The exemption for contributions to Individual Retirement and Keogh Accounts will be expanded. Also, people with pension plan coverage will be allowed tax-exempt contributions up to $1,000 for a newly established account.
- The maximum tax on investment income will be cut from 70 to 50 percent. This results in a reduction in the capital gains tax rate from 28 to 20 percent.
- The present deduction for interest income will be made permanent.

- The corporate income tax will be liberalized to provide investment incentives for business. The new "3-5-15" system effective March 10, 1981, redefines depreciation timetables by allowing corporations to write off the costs of capital within either 3, 5 or 15 years, depending on the type of equipment. A tax credit of 15 to 25 percent will be made available for rehabilitation of certain buildings. These and several other changes allow for accelerated cost recovery, enabling corporations to write off the costs of capital they purchase more quickly than under existing tax laws. These tax incentives are supposed to enable businesses to put more resources into long-term, productive investments. Past experience, however, indicates that these savings are likely to be channeled into greater profits or the acquisition of other firms, and not into real investment. Furthermore, accelerated depreciation encourages firms to invest in less durable goods than they would otherwise. This aspect of the proposal thus promotes "planned obsolescence" rather than productivity and growth.
- The tax credit for oil royalties will be expanded from $1,000 to $2,500 over two years.
- Businesses will be allowed a special deduction for expansion of research and development.

3) Regulatory Reform

- The Council on Wage and Price Stability has been eliminated.
- A Presidential task force has been set up, headed by the Vice President, to examine the cost burden of regulation on industries.
- Several regulations have been postponed or blocked, such as rules pending under the Occupational Safety and Health Administration, the Department of Education and the Fair Labor Standards Act. The Administration has already eliminated the provision guaranteeing walkaround pay for workers who accompany OSHA personnel on inspections.
- The oil industry has been deregulated and several energy conservation measures have been revoked.

4) Monetary Policy

- The new Administration has committed itself to a monetary policy of slow growth in money and credit which they claim is consistent with the overall goals of lowered inflation and expanded growth. Unfortunately, a tight monetary policy means high interest rates, and interest rates, which translate into excessive housing and investment costs, have been a key contributor to inflation.

EXAMINING THE CRITERIA

I. Equity

The first major criticism of the plan outlined above is that it is inequitable in its distribution of benefits and hardships on Americans. Incentives and rewards are heaped upon businesses and the wealthy, while middle and low-income workers who have bourne the weight of inflation and unemployment all along are once again required to make the greatest sacrifice. Business profits will be greatly increased by the reduced taxes and the Congressional Budget Office has estimated that four-fifths of the reduction in the personal income tax rates will accrue to those with incomes above the median.

Most of the budget cuts are in the areas of health, employment, nutrition, housing and other social programs upon which millions of poor or elderly citizens have come to depend over the years. Simply chopping these needed programs out of existence will have a devastating effect on many low-income Americans. Middle income families, many of whom already spend over 70 percent of their incomes on necessities and have been forced into debt will be strapped even further as student loans and federal credit support are eliminated from the budget. The growth in defense spending will pick up some of the slack, but adjustment lags and bottlenecks will prevent the few employment opportunities that do arise from aiding the poor who fall victim to the budget cuts. The chief impact of the expanded defense budget will show up in increased profits for defense related industries and larger capital gains for the wealthy shareholders who have stock in these industries. Once again, we shall see corporations and the rich gain at the expense of the poor.

Finally, the business community will gain from the Administration's effort to reduce federal regulations, while workers, consumers and the needy will lose. Regulations on occupational safety and health, education or consumer product safety, for example, were enacted for the protection of workers and consumers in areas where the market failed to provide adequate service. It is true that some regulations are unnecessarily restrictive, complicated or redundant, and these can certainly be modified or eliminated. But regulations that protect the lives and livelihoods of millions of Americans must not be eliminated merely to appease corporations that will channel the cost savings into profits, not productivity.

II. Scope

The second chief criticism of the Reagan Administration's approach to economic recovery is that the proposed strategy is one-sided and narrow in scope. The Administration avers that government is the cause of inflation because of unwarranted spending and excessive federal regulations. Actually, much of the government spending has grown in response to inflation as transfer payments and federal and military salaries expand to compensate people for rapid price increases. Thus, high government spending is a symptom of inflation, not a cause. Although rising federal expenditures do eventually add to the momentum of price increases, cutting federal spending will not get to the root of inflation. Not surprisingly, the Reagan Administration has not once pointed to the huge corporations, ologopolies and holding companies which have the power to set prices at exorbitant levels as being to blame for inflation.

Regulations may add to business costs, but it is difficult to sympathize with these problems when it is clear that businesses have not pared down profit margins to accommodate this burden, but instead have raised prices. Workers and their families have been sacrificing for years. It is time the business community does the same.

The proposed economic plan is one-sided, as are most strategies that fall under the label of "supply-side economics." The goal of the plan is to reduce inflation and promote growth by reducing the size of government, cutting taxes and adhering to a strict monetary policy. Yet the plan fails to recognize many essential real components of our economic system. In no significant way does the proposed strategy address the important issues of unemployment, income distribution, declining real wages, energy sufficiency, the size of profits or industrial concentration. The validity of a plan which ignores these vital aspects of our economy is questionable in a nation as large and complex as ours.

Supply-side economics is not a specific policy prescription or economic theorem, but is merely a currently popular political catch phrase. Supply-side economics is based on the notion that our slow growth and lagging productivity has resulted from an inadequate capacity for supply. Supply comes from a production function, which is a technical relation, not an economic precept. A production function simply describes the proportion of capital and labor inputs needed to produce a given output based on present technology. For example, it takes one person and one typewriter to produce one letter; any other combination such as one person and two typewriters, will not help. Two people and two typewriters will double output, however. Thus, supply-side economics rests on the belief that businesses have been unable to increase the number of inputs to expand output and must be induced to do so.

There are two trains of thought as to how this might be accomplished. One ideology, popularized by Arthur Laffer, says that cutting taxes has the effect of raising incomes. This is the theory behind Reagan's proposal to cut the personal income tax rates. Laffer theorizes that when people are getting more compensation for any given amount of time worked, they will be induced to work longer hours. This in turn will raise both incomes and tax revenues, thereby reducing the fiscal deficit and calming inflation so that businesses can more easily afford to buy inputs to expand capacity and output.

The major flaw in this seemingly logical theory is that there is no historical or empirical data to suggest that it will work. Most important, the idea that people will work significantly longer hours when wages rise, which triggers the whole process, has never been proved in practice. Very few people have much choice over the number of hours they work except within a narrow margin which is not substantial enough to make this theory work. In fact, the number of average hours worked for the nation as a whole declined from about 1890 to 1940 and has remained stable ever since, despite a wide variety of economic conditions over that period.

The second popular means of stimulating supply is to provide tax cuts or subsidies to businesses as a form of investment incentives. This makes it cheaper for businesses to purchase inputs. This theory is exemplified by the Administration's plan to cut the taxation of businesses. There are two faults with this method. First, there is no guarantee that businesses will use these incentives to expand capacity or pursue new research that will help the economy. The problem has been explained by noting that you can pull a string but you cannot push it. Second, this policy is inequitable in terms of income distribution. These investment incentives merely provide added income to the rich and businesses which have had record profits in recent years while giving no relief to the workers whose real wages have been declining for a decade.

Supply-side economics is not a new idea. In fact, this idea goes back to classical economics and Say's Law, named for the French writer J. B. Say in 1803. Say's Law affirmed that supply creates its own demand. In other words, the idea was that an adequate supply of goods and services is sufficient to ensure a healthy, growing economy. It was assumed that adequate demand would follow automatically.

It was not for another century that economists finally realized that supply theory alone would not solve our economic ills. Around 1900, Alfred Marshall developed a model of the economy in which supply and demand worked together to determine economic phenomena. This notion seems common-place today when every high school student is taught that it is the interactions of supply and demand that form the basis of our economic system. But in 1900, this was a new idea.

John Maynard Keynes helped the world out of a depression in the 1930's with yet another new economic idea. Keynes' theory of fiscal management focused on manipulating fiscal tools such as taxation and government spending in conjunction with business cycles to keep the economy on a steady path. This theory focused on managing demand by adjusting the amount of money and income available for spending and saving. There was a trade-off between inflation and unemployment. When inflation rose, government spending was contracted, and when unemployment rose, the government expanded the economy again.

This policy worked fine until the 1970's when both inflation and unemployment rose to high levels. An acceptable trade-off between the two was no longer available. Thus, supply-side economics has come back into vogue in an attempt to counteract the effects of demand-side policies of the past 40 years.

In sum, the basic criticism of supply-side economics is a simple one: a seller will be useless without a buyer. Investment incentives in themselves are not wrong, but they cannot be justified in terms of economics or equity when there is not adequate demand.

III. Economic Validity

The third major criticism of the Administration's economic revitalization scheme is that it is not based on sound economic methodology. Supply-side economics deals with only part of the problem, ignoring many economic factors which will have profound effects on the outcome of any economic policy. Historical data and empirical studies contradict two key components of the policy: 1) Workers do not tend to significantly increase the hours they work when wages rise (or taxes decline). This means that the personal income tax cuts will not expand output, but will only result in tax revenues insufficient to achieve a balanced budget. 2) In the past, industries have not used tax incentives to expand investment, but have poured them into widening profit margins. Furthermore, economic studies do not indicate that corporations have reduced real investment as a result of the growing corporate income tax.

The plan focuses on the symptoms of inflation rather than attempting to tackle its causes. Cutting the budget will have only a minimal effect on inflation. The Congressional Budget Office has estimated that a $20 billion budget cut will only decrease the inflation rate by 0.5 percent. This means that the effects of the plan will probably be only temporary while inflation revs up for another comeback. This appears to result from a faulty analysis of the economy. The Reagan Administration insists that the current high inflation rate is an outgrowth of two demand-led price hikes in the 1970's. However, both spurts of inflation were initiated and aggravated by supply-side shortages of food and energy. The inflation of the early 1970's was also propelled by increased defense spending from the Vietnam War.

The strategies of the plan are inconsistent with its goals in that many aspects are actually inflationary. First of all, it was increased defense spending that first set off the inflationary spiral in the early 1970's. Second, the deregulation of oil has provoked further increases in the price of energy. Energy prices, which increased 16.9 percent in 1980 have been some of the key contributors to high inflation. Third, the tax cuts which the Administration is proposing to promote growth will add significantly to inflation. Tax cuts have traditionally been used to stimulate demand, not supply. Institutional factors such as rigid work schedules will prevent most individuals from supplying more labor. Thus, they will use the money from the tax relief for added spending. Economist Walter W. Heller has noted that these inflationary pressures could cause the Administration's tax cuts and defense spending to outrun the domestic spending cuts by as much as $100 billion a year. The outcome of the policy would be to increase inflation and perpetuate a larger deficit.

A Better Way

It has been 50 years since the onset of the Great Depression and once again workers find themselves struggling to hang onto the tail of a volatile, unhealthy economy. The necessities of day-to-day living -- food, housing, energy and medical care -- are priced so high that more and more families find themselves falling into debt and lowering their standards of living. Declining real wages do not indicate any relief to this unwanted situation. These problems fall even harder on the poor, the elderly who live on fixed incomes and the almost eight million men and women who are unemployed.

Yet despite this distress, the promise of a new decade and the change in administration have created a spark of optimism for many Americans. We of the Communications Workers of America urge the Reagan Administration to take advantage of this new optimism and implement an economic policy to provide prosperity, well-being and an improved standard of living for all Americans alike. We support the stated goals of the Administration's policy -- reduced inflation and strong growth -- but we cannot support a policy that heaps the burden of sacrifice on the working people of this nation. Middle and low-income families have sacrificed for years, spending over 70 percent of their incomes on needed items, but we have yet to see corporations or the rich give up their luxuries.

Any economic recovery plan that gains the support of Labor must be equitable in its distribution of benefits and burdens, comprehensive and based on sound economic analysis. Not only is the plan proposed by the Reagan Administration inequitable, but it is also narrow in scope and severely lacking in economic reasoning. "Supply-side" economics ignores many important issues in our society such as income distribution, unemployment, real wages, energy sufficiency and industrial concentration. Furthermore, the Reagan strategy is not based on sound economic theory and its assumptions are contradicted by historical data.

We would support an equitable, well-balanced economic recovery policy that contains the following elements:

1) National economic policy must be comprehensive and pragmatically sound. Policies that stress supply incentives but ignore demand will fail in practice for they will create numerous sellers but no buyers. These policies are highly advantageous for the business world but do little to relieve the millions of families suffering from declining purchasing power. Both demand and supply must be considered to ensure equitable economic growth.

2) Full employment must remain a prime national goal.

3) Massive budget cuts attack the symptoms but not the causes of inflation and will therefore provide temporary relief from rising prices. Certainly much can be done to eliminate inefficiency and waste in the government; however, health, education and social programs upon which millions depend should not be removed from the budget to accomplish this end. These programs have been enacted over the years to fill in the gaps where the market system has failed. Specifically:

- Reagan's so-called "social safety net" is entirely inadequate to protect the needy. Medicaid, black lung benefits, trade adjustment assistance, low-income housing and energy assistance, extended unemployment benefits, school lunch subsidies, food stamps and student loans should all be maintained at present levels. CETA jobs should be reinstituted at previous program levels.

- Categorical grants to states and localities for health, educational and social programs should be examined one by one and streamlined or eliminated if necessary. Simply terminating these programs and giving block grants to states will not ensure that the social needs for which the grants were issued will be dealt with properly.

- Social Security benefits levels, current and future, should be maintained with no tightening of eligibility requirements. No society should have to impose upon its elderly or the disabled to pay for a beefed-up defense network during peacetime.

- Federal credit in the form of grants, loans and guarantees should be preserved. Such programs provide credit to those who cannot afford the excessive market rates and also help to counter inflation by putting downward pressure on interest rates.

4) Government regulations that protect the safety and health of workers and consumers should be kept in place. Our national interest certainly cannot be served if society allows workers to be killed or injured on the job and businesses are permitted to market harmful merchandise.

5) Monetary policy should loosen up on interest rates which are a chief cause of inflation, especially in the housing sector.

6) Tax reforms are needed to reduce the burden of inflation on Americans since tax rates rise as inflation artificially raises incomes, pushing workers into higher tax brackets. Tax reform can be equitable and noninflationary if handled properly.

- Massive proposed across-the-board tax rate cuts are inflationary and inequitable, providing four-fifths of the relief to individuals with incomes above the national median. Tax rate cuts should be proportionate to income to ensure equity and should be made in moderation to prevent a further onslaught of inflation.

- Income tax reform should include increases in the standard deduction and personal exemptions.

- Investment tax credits should be augmented with employment tax credits. There is no economic reason to prefer investment over employment credits. Employment tax credits would promote full employment and add to productivity, since labor has been a major contributor to our nation's productivity over the years.

- Accelerated depreciation tax methods for corporations should not be implemented unless corporations will put the savings from such changes into added productivity. Alternately, the government should impose excess profits taxes on businesses to ensure that corporations do not reap unfair benefits from price increases at the expense of consumers.

- Tax credits for oil royalties should not be increased because this only adds to the incomes of the rich.

- Regressive federal excise taxes should be eliminated. Excise taxes are inequitable and are generally passed on to consumers in the form of higher prices.

- A state sales tax buy-back program would ease pressures on volatile food prices.

- Social security payroll taxes could be reduced and disability benefits financed out of general fund revenues.

7) Energy policy should focus on development of alternate energy sources to achieve national self-sufficiency. National energy strategies should include:

- Maintain government regulations and credit support for conservation and weatherization measures, mass transportation projects and development of alternative energy sources such as wind, tide, coal, solar, nuclear, geothermal power and synthetic fuels.

- A quasi-governmental corporation should be established to research and develop alternate energy sources, regulate imports and serve as a yardstick to measure the performance of private sector energy production.

8) Productivity should be encouraged through efforts to maintain job security and full employment.

- Worker participation projects can greatly contribute to labor productivity.

- Advance notice of technological change and plant closings or relocations can enhance worker effectiveness.

- Occupational safety and health standards should not fall victim to ill-conceived budget cuts.

- Relocation allowances and occupational training programs should be available to all workers to utilize workers' talents and avoid long, unproductive periods of unemployment.

9) Labor is our nation's greatest resource. National policy must recognize this fact and require corporations to take an active and responsible role in dealing with workers. Talk of economic recovery will be meaningless until the Reagan Administration learns to focus on people, not profits.

Senator Quayle. Mr. Birch?

Mr. Birch. Senator, I will put my formal submission in the record and try to summarize it for you.

Senator Quayle. Thank you.

Mr. Birch. We have been addressing at our research program at MIT the problem of how to produce 15 million jobs we are going to need, that you mentioned in your introductory remarks. Our approach has been a little different from most. We build up a file of about 5.5 million business establishments, which is something like 80 percent of all of them. For each one, we looked at its history, in 1969, 1972, 1974, 1976 and created some software so we could sort of look at the structure of the economy from the ground up, business by business and place by place. We also looked carefully at the aggregate numbers.

I think it is helpful to think of a place like a bathtub, where you have sort of flows in and flows out of jobs. You can have firms creating jobs by either starting up or moving in or expanding, or they can die or move out or contract.

I think the first thing we found is that the movement of firms is virtually negligible as a source of jobs and has very little effect.

The second thing that I find quite interesting is that the loss rates are quite high and are about the same everywhere. Everyplace in the United States loses about 8 percent of its jobs every year, and it does not seem to vary very much from place to place. In fact, Houston loses a higher percentage of its jobs, slightly, than some of the Northeastern and Midwestern cities do because of more dynamism in the Houston economy.

It is also a very high rate. It means that about every 5 years, we turn over 50 percent of our job base everywhere in the country, which means there is a rather extraordinary potential for transformation if we were to choose to change the mix. So it is critical to learn who is replacing the jobs that are lost every year, to keep the tub more or less even, or at least, perhaps, growing.

We find from our work that, first of all, they tend to be small, they tend to be young, they tend to be volatile. But from the point of view of this hearing and this committee, I think they tend to be overwhelmingly in the service sector. So for the 19 million new jobs that we put on during the 1970's, only 5 percent of those were in manufacturing; only 11 percent were in goods production as a whole—manufacturing, mining, agriculture, forestry, fishing, construction—anybody who makes anything; and 89 percent were in the service sector.

That trend has reached the point now where we only have about 12 or 13 percent of our labor force engaged in actual manufacturing operations. We are virtually out of the manufacturing business. We have focused a lot today on manufacturing productivity, but in fact, most of our growth is in sectors of the economy that have nothing to do with manufacturing and whose productivity, by the way, is very difficult to measure. The service sector productivity is, at best, ill-defined, and perhaps not easily measured at all.

The older the city and the more northern and midwestern the area of the country, the more what I have just said is true.

I think it adds up to a very basic restructuring of the economy. It is a shift from manufacturing to services, but I do not really think that is what it is. That is what it looks like statistically. It is really a shift from what I call hardware to thoughtware, from things that we make, which we are doing less and less of, to activities that in one way or another involve our thinking about something. And if there is a high thought content, it will tend to do it here in the United States; if there is not, it tends to go somewhere else to be done. Now, there is a lot of thinking left in the high tech sector of manufacturing, for example, and there is a lot of growth in that sector. It is a shift from larger to smaller scale. The economies of scale in the service sector are very small. Two 11-year-old children started up a very successful nationwide computer software company a few months ago, and it is a classic example——

Senator **Quayle**. Where?

Mr. **Birch**. Out in California. They introduced their first nationwide product. It was very successful—not a toy or a game, either. A very sophisticated file-handling system, if I remember. And then they started up a second nationwide product. They have to ask permission to stay up past 8 o'clock at night, but they are running a nationwide corporation. That gives you some feeling for the ease of entry into the services as distinct from, say, the automobile industry, which John Delorean has attempted to enter with some difficulty.

I think it is primarily also a shift from physical to human capital, and from the point of view, again, of your hearings, I think this is most important. It is investing more and more in education and less and less in plants, in one form or another. I took a look at the numbers as to what that will involve, and generally, it looks like we need two different kinds of investments. The first is sort of a general upgrading. If you look at the average manufacturing plant, about 15 percent of the labor force is involved in professional, managerial or technical kinds of things, and another 12 percent in clerical, and the low end, about 50 percent of the labor force, is either an operative, a paint-sprayer, a forklift operator, or a laborer or a service worker of some kind. When you move into the growing sectors that we see creating most of the 19 million that we saw, between 35 and 65 percent are professional, technical, and managerial; 20 to 30 percent are clerical, and only 20 percent are on the low end. That means a rather startling redistribution of what the school system produces as an output. And I was very struck a month or so ago when I was out in St. Louis, and asked what the St. Louis school system was doing about this and discovered there was not a single computer terminal in the entire St. Louis school system. Given that a striking percentage of jobs would be in one way or another associated with the computer, as George Ansell mentioned this morning, that is an enormous mismatch between what the economy will need and what the school systems are producing.

The second issue, of course, is the retraining one. It has already been mentioned, but there is going to be a significant drop in the need for craftsmen, a significant drop in the need for the operatives, the paint-sprayers and the forklift truck drivers. And I think that shift in the mix will take place more rapidly than a normal attrition process will account for. So I would agree whole-heartedly that there has to be a fairly intensive national focus on how to take people who are being obsoleted and move them into the other forms of activity that will be needed. I think that will be very important.

Interestingly enough, the shift is also a shift from an independent to an interdependent economy. It has gone unknown for the most part, but we now export about $60 billion worth of services a year, for a net export of about $35 billion. We are a net importer of about $35 billion worth of manufactured goods—which means we are the single largest exporter of services in the world, exporting about 20 percent of the world's volume of services as a nation. That has made us far more dependent as a nation than we might otherwise have been. Our exports and imports as a percentage of our GNP have doubled in the last 30 years or so and has gone up astronomically in current dollar terms. It means that there are many things we now depend on other nations for that we did not 20 or 30 years ago, and there are some major national security implications of this, which I do not want to get into, but I think are terribly important for what we are talking about here.

You asked me to comment in your invitation briefly about what is happening in New England and the Midwest and some of those areas of the country, and it is very fascinating. I have looked at New England very carefully. We shifted more rapidly in this direction than most. We shifted out of manufacturing, into services; we lost 660,000 manufacturing jobs; put on 1.1 million service jobs in the middle seventies. We paid a tremendous price for it. Our unemployment rates were like Michigan's are today.

Senator **Quayle**. And Indiana.

Mr. **Birch**. And Indiana, yes, unfortunately.

But it gave us a great source of strength. And today, having made that transformation and having absorbed the dislocations, which we did—many of my neighbors changed occupations and jobs in the process of doing that—Massachusetts now has, in recent times, the second-lowest unemployment rate of the large States in the country, second only to Texas, and we are, in fact, considerably ahead of California and Florida, at this point, in that category. Connecticut is in better shape than Massachusetts; it just is not in the top 10. New Hampshire and Vermont are in better shape than Connecticut. So, having made this shift, having relied on smaller businesses and the service sector as a source of growth, we are in very good shape right now—in fact, better off than almost anyplace in the country.

I noticed also in Michigan where I was recently that in fact, Michigan is hurting badly in terms of its loss of about 135,000 manufacturing jobs in the last 11 years. But they gained some 450,000 service jobs that nobody is talking about, and in fact, there is a boom in the service sector in Michigan, and if you were just to stabilize the manufacturing aspects of Michigan, you would have a very healthy economy much like that in Massachusetts.

I think for the rest of the economy, the direction we are going in makes a great deal of sense. I think we are becoming the creativity center of the world. I think it capitalizes well on our traditions of inventiveness, entrepreneurship, individualism. I suppose the bottom line is, is it working? I am fairly optimistic about that. I think it is working very impressively. I think we have 400,000 to

500,000 people starting up new businesses ever year, and I read the other day and have not confirmed it that that is about 600,000 in this past year, in 1981, during the depression; it accelerated during that period. In the last 10 years, we created 19 million new jobs, we employed a greater percentage of the labor force than ever before in history, and I do not see anything short of a Third World War stopping it.

So, in a world of pessimists, I am fairly optimistic about where we are going. I think it is going to require a major transformation in the way we invest in human capital to get there—which is the purpose of your hearing—but I do not think we have any option but to move in that direction, and I think reaching back will get us nowhere.

Thank you.

[The following was received for the record:]

Statement by

David L. Birch
Director, MIT Program
on Neighborhood and Regional Change

before the

Senate Subcommittee on Employment
and Productivity

WHO CREATES JOBS?

March 26, 1982

(Reprinted from the Fall, 1981 issue of
The Public Interest)

Who creates jobs?

DAVID L. BIRCH

As a nation, we must create about 15 million new jobs in the 1980's to employ all of our expanding adult population. This is less than the 19 million we created in the 1970's to absorb "war babies" into the labor force, but it is still quite a large number. Assuming that present attitudes toward government extend at least a few years into the decade, the government sector as a whole will produce no more than one-quarter of the needed 15 million. The private sector will have to produce the rest. All of this will have to take place during a period in which the structure of the U.S. economy is undergoing very basic changes.

As a group of us at the M.I.T. Program on Neighborhood and Regional Change began to think about how the nation will meet this challenge, we came to appreciate how little we knew about the processes by which job creation takes place. Most students of the economy have tended to focus on the aggregate measures of economic change flowing out of the GNP accounts, and have not probed the activities of the individual companies that make it all happen. These analysts may guess about what kinds of corporate behavior are causing shifts, but they never really know for sure.

On the other end of the spectrum, those who have studied the behavior of individual corporations rarely have added up the firms to see how they come together to create the whole. "Input-output analysis" is one of the major exceptions to this, focusing as it does on transactions between businesses in the economy. Welcome as this innovation has been, it has suffered (as have other attempts to aggregate parts to form economic wholes) from the enormous cost of collecting the necessary data. As a result, it tends to be out of date, and its results are expressed in terms of transactions between whole industries, not between firms.

Our inability to understand the gap between the "micro" economy and "macro" economy is now seriously hampering efforts to develop policies that will generate jobs for the people and the places that need them, without causing inflation at the same time. We know very little about who the major job creators are, where they are active, who controls those jobs, and who is most likely to respond to changes in economic policy. In the absence of such knowledge, national policy has been to stimulate the entire economy as though it acted as a single unit, using instruments like broad tax incentives, easier access to money, and public works programs of various sorts. This can be a very expensive and inflationary approach if, in fact, most of the recipients do not use the incentives to increase employment and productivity. What we need, and have lacked, is the ability to focus our incentives on those who will make good use of them without wasting taxpayers' monies on those who will not.

Frustrated by the inability to relate micro to macro, and thereby to discover how change takes place, our group at M.I.T. began casting about for a new data source that would permit us to analyze inexpensively a large sample of the entire corporate population, one establishment at a time. Our search uncovered the so-called DMI file created by the Dun and Bradstreet corporation. The file contains records for about four million establishments, about 80 percent of the total recognized establishments in the country. We devised a way to combine the data for each establishment for four different years (1969, 1972, 1974, 1976) to obtain a history of the development of each establishment during this period. In the process we added in new firms that were formed along the way, yielding a total of about 5.6 million establishments over the seven-year period. We also edited the records extensively to eliminate establishments for which the data seemed at all questionable. When we were done, we were able to trace what happened to the employment, sales industry, corporate affiliation, age, and location of each establishment over this time. By aggregating establishments, we could see who was contributing to job growth in different periods and places.

TABLE I. *Percentage of Job Losses and Gains by Growth Rate for States*[1]

STATE GROWTH RATE[2]	FAST	MODERATE	SLOW	DECLINE	U.S. AVERAGE
1969–72:					
Gains	13.8%	10.9%	8.5%	7.5%	10.4%
Losses	8.3	8.0	7.7	8.4	8.1
Net	5.5	2.9	.8	–.9	2.3
1972–74:					
Gains	12.4%	10.1%	9.0%	—	10.9%
Losses	7.2	7.2	7.6	—	7.2
Net	5.2	2.9	1.4	—	3.7
1974–76:					
Gains	15.1%	11.4%	10.7%	8.3%	11.2%
Losses	8.9	8.7	9.7	9.3	9.2
Net	6.2	2.7	1.0	–1.0	2.0

[1] Source: M.I.T. Program on Neighborhood and Regional Change.

[2] The four classes of employment change are: Fast (over 4 percent per year), Moderate (2 to 4 percent per year), Slow (0 to 2 percent per year), and Decline (less than 0 percent per year). On the average, this breakdown divides states into four roughly equal groups, although the size of the groups in any particular year is sensitive to the business cycle.

Job creation is what really matters

For any particular place, it turns out that there are six quite different ways that an establishment can affect an area's job base. On the plus side, jobs are added to the pool each year whenever a new firm starts up, an existing firm expands, or a firm located elsewhere moves in. Jobs are lost whenever an establishment closes its doors, lays off people, or moves out. We have come to call these six "job flows": *births* (a new firm starting), *expansions, in-migrants, deaths* (an existing firm closing its doors), *contractions,* and *out-migrants.* The extent to which an area's job pool expands or contracts in total over the year depends on the relative balance between these flows during the year.

We discovered a number of interesting things about the job flows. First, *virtually none of the employment change in an area is due to firms moving,* in the sense of hiring a moving van and relocating. Many firms move short distances each year, but virtually none move from one metropolitan or rural area to another. When a move does occur, it is widely publicized in the press, and it is easy (without evidence to the contrary) to begin to pin all of an area's economic woes on the fleeing firm. Any hard look at the numbers, however, will show that fleeing firms take only a small number of jobs with them, and that for every firm that flees there tends to be another firm with a similar number of jobs moving in. The net effect of firm "migration" is thus negligible relative to the job base (and the other job flows) for most places.

The second striking phenomenon observed in the analysis of employment change is the constancy of job losses. Every area in the United States seems to lose jobs at about the same rate, regardless of how rapidly the net job pool is expanding or contracting. Table I sorts states into different groups by growth-rate and displays the gains and the losses for each group in each of the three periods studied. As can be seen, virtually all the differences in the net change are due to differences in the gain rates, the sum of the loss rates being remarkably similar across states. There is a variation in average loss rates over time with the business cycle in the expected directions, but all states seem to float up and down together on the loss side, varying between seven and nine percent.

The same phenomenon appears to hold across cities, and even within them. Table II summarizes the loss and gain rates for ten metropolitan areas for which the neighborhood location of each business has been located. The differences in loss rates are relatively small, and if anything the more rapidly growing areas also experience the highest losses. Houston and Charlotte show somewhat higher loss rates than Worcester and New Haven, for example. Again, it is the variation in the gain rates that is so large, the rapidly growing areas replacing lost jobs at two or three times the rate of the declining ones. The same general phenomenon is ob-

TABLE II. *Percentage of Firms Gained and Lost in Ten Metropolitan Areas, 1972-76*[1]

AREA[2]	PERCENT GAIN	PERCENT LOSS	PERCENT NET
Houston	62.7%	35.7%	27.0%
Charlotte	48.0	40.4	7.5
Dayton	36.4	31.4	5.1
Rochester	33.7	29.3	4.5
Boston	37.4	33.7	3.8
Baltimore	36.5	32.9	3.5
Hartford	36.6	35.5	1.1
Worcester	24.6	25.1	– .5
New Haven	27.0	29.5	–2.6
Greenville	26.9	35.1	–8.4
U.S. Average	37.0%	33.7%	4.1%

[1] Source: M.I.T. Program on Neighborhood and Regional Change.
[2] Standard Metropolitan Statistical Areas.

served for the central cities and suburbs within these metropolitan areas.

The average loss rate is also quite high. An eight percent loss every year means that half of an area's jobs and establishments must be replaced every five years for the area simply to break even. We seem to have developed an economic system in which experimentation and risk-taking are very common. As a consequence, we experience and tolerate very high failure rates. The more dynamic the local economy (e.g., Houston) the greater the risk-taking and the greater the proportion of firms that fail. It could easily be argued (without being facetious) that one of our greatest strengths as a nation is our capacity for failure—the grace and even enthusiasm with which we accept those who try and fail and come back to try again. To our counterparts in the industrial world, this churning in our system seems extraordinary. We take it for granted, and at times even try to stifle it under the misguided banner labeled "job retention." *The reality is that our most successful areas are those with the highest rates of innovation and failure, not the lowest.* Areas that are declining are not declining because their rates of loss are higher. They are declining because they are not competing effectively for new jobs.

Those small, volatile job replacers

Since we turn over such a large proportion of our job base every year—in all industries and all areas—the overall character of our economy is affected quite quickly by the nature of the job replacers. It no longer takes generations to transform our economy—only a decade or two. We must thus focus our attention on the job replacers. Who are they? In what sectors of the economy are they found? How big are they? How old are they? Where are they located?

For one thing, job replacers tend to be small. Of all the net new jobs created in our sample of 5.6 million businesses between 1969 and 1976, two-thirds were created by firms with twenty or fewer employees, and about 80 percent were created by firms with 100 or fewer employees (see Table III). Smaller businesses more than offset their higher failure rates with their capacity to start up and expand dramatically. Larger businesses, in contrast, appear rather stagnant. They may be expanding output with more capital equipment (although those who study productivity suggest that this has not been the case recently) or they may expand by opening opera-

TABLE III. *Percentage of Jobs Created by Size of Firm and Region*[1]

NUMBER OF EMPLOYEES IN FIRM	PERCENT OF JOBS CREATED				
	Northeast	North Central	South	West	US. Average
0-20	177.1%	67.2%	53.5%	59.5%	66.0%
21-50	6.5	12.0	11.2	11.6	11.2
51-100	–17.4	5.2	5.5	6.3	4.3
101-500	–33.3	3.1	9.4	9.3	5.2
501+	–32.9	12.4	20.4	13.3	13.3
Total	100.0%	100.0%	100.0%	100.0%	100.0%

[1] Source: M.I.T. Program on Neighborhood and Regional Change.

tions abroad. Whatever they are doing, however, *large firms are no longer the major providers of new jobs for Americans.*

Another distinguishing characteristic of job replacers is their youth. About 80 percent of the replacement jobs are created by establishments four years old or younger (see Table IV). Not all small businesses are job creators. The job creators are the relatively few younger ones that start up and expand rapidly in their youth, outgrowing the "small" designation in the process.

Job creators are also quite volatile. The road to future growth is a tortuous one indeed. We had thought that a firm grows and develops much like a human being: It starts small, grows smoothly and rapidly during a "growth phase," matures and stabilizes for some period, and eventually becomes out-dated and falls off. Our research now suggests quite a different process. Dynamic, job creating establishments appear to oscillate, or pulsate, constantly. Periods of expansion are the best predictors of future decline, and declining periods are the foundation upon which future business growth is based.

TABLE IV. *Percentage of Replacement Jobs Created Between 1974 and 1976 by Age of Establishment and Region*[1]

AGE OF BUSINESS	PERCENT OF REPLACEMENT JOBS CREATED			
	NORTHEAST	NORTH CENTRAL	SOUTH	WEST
0-4	75.5%	80.8%	80.4%	80.9%
5-8	10.4	8.4	9.9	8.8
9-12	7.5	6.0	5.1	5.5
13+	6.6	4.8	4.6	4.8
Total	100.0%	100.0%	100.0%	100.0%

[1] Source: M.I.T. Program on Neighborhood and Regional Change.

TABLE V. *Performance of Establishments based on Their History of Growth*[1]

1969-1972	PERCENT IN 1974-1976 WITH:		
HISTORY	RAPID GROWTH	RAPID LOSS	DEATH
Rapid Growth[2]	11.1%	16.5%	4.3%
Small Change	9.4	7.6	24.6
Rapid Loss[2]	21.9	8.0	12.6

[1] Source: M.I.T. Program on Neighborhood and Regional Change.
[2] Greater than 50% change.

Stable firms, those that have somehow isolated themselves from the ups and downs in the world around them, are the most likely to fail in the end. A sample of 1.4 million establishments that existed throughout the 1969-76 period shows that establishments that grew sharply in the past are the most likely to decline in the future, that recently declining establishments are the ones most likely to grow in the future, and that stable firms are far and away the most likely to go under (Table V). These oscillations from one year to the next are much greater than the average growth or decline that one would expect from a "life-cycle" model of corporate change. Those firms that insulate themselves from fluctuation appear to have cut off the very vitality that keeps their counterparts going. Just as failure appears essential to our system, so does instability.

Recent job replacers overwhelmingly tend to be providers of services—broadly defined to include all those private activities outside of the so-called "goods-producing" sector (manufacturing, agriculture, mining, and construction). During the period we studied, manufacturing firms in our sample actually lost jobs on balance, this small loss being offset by substantial gains elsewhere. The older, more northern, and more urban the area, the more this was true. Manufacturing picked up slightly nationwide during the latter part of the decade, but by the time the 1970-1980 U.S. figures were in, manufacturers as a group had created only 5 percent of the net new jobs in the 1970's and the goods producers as a whole accounted for only 11 percent. The other 89 percent were in services of one kind or another. Just as we moved in the 1820's and 1830's from being a basically agricultural society to being an industrial one, so now are we rapidly abandoning our heavy industrial base in favor of jobs that demand greater use of our minds and less use of our muscles and dexterity.[1]

---

[1] There are bright spots within the sluggish manufacturing sector including very small manufacturers and high-technology, high "thought-content" firms. The bright spots are not bright enough, however, to significantly offset the general malaise elsewhere.

These basic shifts in the nature of job replacement are not unique to the U.S., although we tend to be further advanced along this path than other nations. Nor are the findings unique to our data set or approach. Others, here and abroad, using different ways of measuring the behavior of individual firms, are finding much the same thing.

The transformation is thus a fundamental and far reaching one. We are moving from manufacturing to services, from hardware to "thoughtware," from large-scale capital-intensive companies to smaller-scale labor-intensive companies, and from a dependence on physical capital to a dependence on human capital. These shifts have been facilitated by the increasingly international nature of our economy. We no longer have to make what we consume. Instead, we increasingly create and market products that we let others assemble for us. As a result, our exports and imports have risen from 7 percent of GNP in 1950 to 15 percent in 1979, and our private assets abroad have increased from $19 billion to $377 billion over roughly the same interval.

Intervene or improve the climate?

Those who would try to influence our economic system during this sometimes difficult period of transition are faced with some very thorny problems. At the heart of the matter is the age-old problem of choosing between a direct interventionist policy or an indirect improve-the-climate policy.

Those advocating a direct policy would have us provide assistance to individual companies or industries through government actions of some sort—loans, loan guarantees, contracts, grants, import restrictions, etc. Going the climate-improvement route involves changing the general tax and regulating environments in ways that entrepreneurial business people find attractive, thus letting the market determine who flourishes and who does not.

A direct policy is, and always has been, a "natural" for governments. It gives them a feeling of accomplishment—a series of deals (and jobs created) that they can point to with pride. Thus, it is not surprising to find that we have a broad array of such programs spanning several administrative branches of government, from the federal to the state and local levels.

In view of our findings on job creation and shifts in the economy generally, it appears that a direct intervention will become increasingly difficult (and frustrating) to administer. How, for instance, is an official at any level of government going to decide whom to aid? In the past, the most natural choice has been the large, stable, well-known companies because they could easily be identified (their well-financed lobbyists made sure of that) and because their risk of failing in the short-term was minimal.

But these are the companies that are the least likely to create jobs. And assisting them has a long history of not working. The Dutch and British, who have gone much farther down this road than we, have had many failures and very few successes. Our own experience, while far less extensive, is not too encouraging either. Propping up large-scale, noncompetitive private bureaucracies seems to subsidize incompetence rather than cure it.

If these same interventionists choose to redirect their efforts toward the smaller end of the scale, their problems are no less severe. How will they pick the one out of 100 or 300 small firms that will become a major job creator? How will they absorb the enormously high transactions cost associated with making thousands (or hundreds of thousands) of small-scale interventions? How will they endure the embarrassment and threat of scandal associated with a project failure rate of 30, 40, or 50 percent? These problems are not unique to government agencies. They explain in great measure why banks, insurance companies, pension funds, and university endowments are equally hesitant to become involved in small-business affairs, and why some very high percentage (in the range of 80 to 90 percent) of all startup and expansion capital for smaller businesses comes from immediate, personal sources: personal savings, friends, and relatives.

Furthermore, smaller businesses apparently do not want direct assistance. Not a single recommendation coming out of the recent White House Conference on Small Business asks that government programs or regulations be increased. The practically universal cry of owners of small businesses is that governments establish a more favorable climate and let entrepreneurs run their businesses as only they know how.

This cry, and others like it, have led many in Washington to consider seriously the value of a predominantly "climate" policy. Its purpose would be to create an environment in which innovative, job-creating firms flourish. Since smaller businesses appear to be playing an increasingly important role in the economy, special attention is being paid to their concept of a good economic environment. Following their recommendations to the White House Commission on Small Business, the list of improvements would include:

(1) lower personal taxes on capital gains, (2) lower estate taxes (so companies may be kept within a family), (3) a slower rise to the full corporate tax rate (to compensate for the unintended progression into higher brackets caused by inflation), (4) fewer and simpler regulations, (5) simpler depreciation rules, and (6) equal opportunity for smaller business in goverment procurements.

We should not infer from the recent interest in climate policies that they are universally embraced by governors and mayors. For one thing, there would be a relatively small role for these elected and appointed officials to play in the management of our economy. There are also definite problems associated with depending entirely on smaller businesses to create jobs. They have little capacity for example, for conceiving, developing, and marketing the kinds of products and services that can only be provided on a large scale—jet aircraft, large-scale integrated circuits, space shuttles, communications satellites, telephone service, etc. Smaller businesses seem to function much better as subcontractors to larger companies in these situations, relying on the larger company for the design and international marketing aspects of the job.

The reindustrialist illusion

The choice between direct intervention and climate policies will ultimately depend on what we wish to accomplish. An increased emphasis on business climate will more than likely accelerate the trend toward the dominance of smaller service-sector firms as the sources of new jobs in our economy, an increasing dependence on foreign countries for manufactured goods, and an increasing dependence on investments in human capital rather than physical capital, with all the attendant declines in measured productivity that would entail.

There are some who find this natural trend threatening. Pointing frequently to the Japanese and their increasing dominance of what used to be many of our markets, they advocate that we "reindustrialize"—that is, go back to investing more in plants that will make things more efficiently so we can meet foreign competition in markets we are now losing. Since our private sector companies do not seem to be doing this on their own, the argument goes, some form of intervention is called for.

There are several problems associated with this attempt to roll back the clock. First, it is not clear what "universal solvent" we dip our noncompetitive industries into so that they suddenly become creative again, invest in new technologies, and work harder. Protective tariffs and import restrictions will certainly not accomplish it. Forced savings by households and businesses to finance needed physical capital (a common practice in Japan) is certainly not part of our culture.

Secondly, it is not clear that we *should* devote a tremendous effort to find a universal solvent. In our almost compulsive fascination with the Japanese and the effectiveness with which they have competed in certain markets (automobiles, electronics, watches, etc.) we lose sight of our competence in producing the "thoughtware" upon which so much of the Japanese hardware is based. It is not an accident that of the 176 Nobel science prizes awarded since 1950, the United States has received 93, the European community another 68, and Japan only two. We dominate the thoughtware field just as others are coming to dominate hardware production. And the emphasis in many fields is shifting from hardware to thoughtware. It was not uncommon five years ago for 90 percent of the cost of a computer installation to be in hardware, and only 10 percent in thoughtware (software, as the computer industry calls it). Five or ten years from now, it will not be unusual for those percentages to be reversed—80 or 90 percent software and only 10 or 20 percent hardware. For many of the same reasons, *Robotics Age* (one of the journals of the blossoming robot industry) recently changed its name to *Robotics Age: The Journal of Intelligent Machines*, saying: "... the character of the industrial robot market is rapidly moving towards increased intelligence in the controller. As this happens, the nature of the problems, both in design and application, is quickly changing from hardware to software."

What it comes down to, then, is this: Do we want to try to beat the Japanese (and others like them) at their game or play our own game instead? The evidence we have collected suggests that: (1) the odds of our beating them at their game are slim, and (2) that we are doing quite well at our own game if we can recognize it for what it is. We have spawned an extraordinary number of idea factories—in universities, businesses, and government—that generate a high percentage of the world's original ideas and that now provide employment for a greater percentage of our work force than ever before in history. In the absence of a major international conflict, this division of labor between ourselves and those who choose to make things is not necessarily bad and could well, given present trends, turn out very much in our favor.

We pay a price during a transformation of this sort. The relatively few workers who still make things in factories[2] must adjust to different kinds of employment. Our enormous mobility gives us an advantage over other nations whose people are less mobile. But we are still left with older, skilled craftsmen for whom moving and retraining does not come easily.

Also, in the unfortunate circumstance that we enter another world war, our dependence upon others for manufactured goods could turn out to be a major liability. It already is. Every time imports rise as a percent of our GNP, our dependence increases. Furthermore, to the extent that our dependence is concentrated in selected areas (transportation equipment, electronics, computers, steel, petroleum) the effect could be even more crippling. We have experienced it recently in oil; the Russians are now feeling it in food.

National security is a major, compelling argument for stemming the present tide. It is a strong argument, and is not easily dealt with. Patriotism alone will not make our automobile plants or our steel plants or our computer plants more competitive. Nor are trade barriers and protection likely to lead to the superior technology we would need to succeed in the very conflict we are hedging against. In short, we still seem to lack the "solvent" to transform our noncompetitive industries in peacetime even if we decided, as a national policy, that it was important to do so.

Thus develops a more interdependent collection of nations in which we play a specialized role. Luckily ours is one of the more interesting and promising parts in the play. And we seem, without strong supporting policies, to be developing a mix of larger and aggressive smaller businesses to play our role well. Perhaps we should spend less time worrying about what the Japanese do better, and worry instead about how to do better what we do best.

---

[2] About 13 percent of the workforce is still engaged in actual manufacturing operations, as distinguished from those who manage or sell or account for the goods made by the others in firms labeled "manufacturing."

Senator **Quayle**. Did you say 600,000 new business startups?

Mr. **Birch**. I read that, yes. That is up only 10 or 12 percent from the national average of the last few years. We start up a phenomenal number of new businesses every year—which, by the way, is unique among the nations of the world. Our capacity for starting up and shucking businesses is extraordinary. The Europeans are dumbfounded at our capacity for doing this.

Senator **Quayle**. Is this a growth that has been constant over the last decade or the last 4 or 5 years?

Mr. **Birch**. We tend to replace something like 8 to 10 percent of our businesses every year, and have for some time. And as the number of businesses has grown, the number of failures and replacements has increased. And in general, business startups tend to accelerate during recession, almost out of desperation. That is, you lose your job, and you can't work in an automobile factory, or Boeing lays off many people in Seattle, or NCR lays off a lot of people in Dayton—one of the reactions to that is, you can either move or start up a business. And the start up of new business tends to be counter-recessionary and tends to be a phenomenon of recession in hard times. I do not think it is choice so much as desperation, but it is a phenomenal phenomenon.

Senator **Quayle**. Thank you.

Mr. Kutscher?

Mr. **Kutscher**. Thank you, Senator Quayle. I appreciate the opportunity to describe some of the work we are doing at the Bureau of Labor Statistics.

I share with Mr. Birch the need to focus on the entire economy and not just the need to focus on manufacturing, because I think you can get a very misleading picture.

In my written testimony, which I will submit for the record, I describe difficulties of analyzing and defining shortages, and the difficulties we have in measuring surpluses and shortages, but I would like to concentrate in my brief remarks this morning on some of the findings of the regular projection's program of the Bureau of Labor Statistics, which looks 10 years ahead at some of the employment categories that are in great demand and some of the categories that we expect to see in surplus.

Overall, over the next decade, of course, the labor force will be growing at a decreasing rate of growth, because of a change in the birth rate beginning in the late fifties and early sixties, so that the number of new jobs that the economy needs to create is not increasing at an increasing rate. With this slowing in the rate of growth of the labor force, there will be fewer young people in the labor force. By the end of this decade, we expect to see about 2.6 to 2.7 million fewer people aged 16 to 24 in the labor force than there were at the beginning of the decade.

Also, because of change in birth patterns and change in labor force activity, the net additions to the labor force will be dominated by women. Two out of three of the net additions to the labor force in this decade are expected to be women.

Also, the birth rate among blacks in the population did not begin to decline quite as soon as for whites, so that 1 out of 5 of the net additions to the labor force in the 1980's will be blacks, although they represent a little over 1 in 10 out of the total population.

If you look at the various sectors of the economy, again, I share with Mr. Birch the need to focus on the service-producing sector, because that is the part of the economy from a job orientation that is growing the most. About 8 out of 10 of the net additions to jobs are expected to be in the non-goods-producing area throughout the remainder of this decade—although there are selected manufacturing areas, largely the so-called high-tech areas, such as computer manufacturing, or some of the instrumentation areas, that we expect high employment growth.

In my testimony, I list the industries in which we expect high employment growth and I also delineate those industries for which we expect rapid declines. From an occupational orientation, of course, the shifts that the economy will have over the next decade tend to reinforce a lot of the trends that have taken place in the past, namely, that the economy will need an increasingly professional and technical work force, will need an increasingly clerical work force, and those occupations that are associated with manufacturing operations will not grow as rapidly. However, there is a category called service workers that probably is not examined that much, that is also one of the more rapidly growing areas of the economy.

So that even though we may have a factory—although I would like to see it—that will operate for 24 hours without a worker being present, we probably will have guards around the factory, we will probably have people who will come in and service the machines when they break down, we have to have someone to install the machines, and many other aspects such as accounting will require workers, so that when you examine the total economy, I think you do not get quite the same picture as when you concentrate on just the manufacturing aspect of this expected technological change.

We have done an in-depth look at the supply and demand picture for college graduates over the next decade. Because of the changes in our birth rate, we had a very large number of people who entered college in the 1970's and will continue to do so until at least the middle of this decade. The consequences of their demographics changes are more college graduates than there are jobs that require a college degree to perform. We estimated that during the 1970's, 1 out of every 5 college graduates took a job that did not require a college degree to perform that job. About 1 out of 10 college graduates of this period took a clerical job. As we enter the 1980's, we see a somewhat similar pattern, as we continue to produce more college graduates than the job market requires; at the same time we have a reservoir of 3.8 million people with college degrees who are working in jobs that do not require a college degree to perform.

Now, I should not leave the implication that college people are unemployed, in fact, they have very low unemployment rates compared to the remainder of the work force. What college graduates do who cannot find a job requiring a college degree is to drive the work force down so that they take the jobs that somebody with a little college or a high school degree would normally get, and the job market gets pushed down because of the oversupply of college graduates.

However, even though I have described the broad picture of a very large number, which we estimate to be in the range of 200,000 to 300,000 annually oversupply of college graduates, there are a number of fields in which there are shortages of college-trained individuals. Some of the engineering fields are likely to see shortages, particularly aeronautical and electrical—Mr. Fechter tells me I should be adding industrial to this list because examination indicates that category might also be in short supply. In general, however, we are not quite as pessimistic on the overall supply-demand for engineers as some others are, because the engineering enrollment started up in the midseventies, and the engineering schools are going to be turning out an increasing number of engineers, which we think will come closer to satisfying the need, at least during this decade.

Senator QUAYLE. So you think that there will not be a shortage in the mideighties, then?

Mr. KUTSCHER. That is right—overall, over all of the broad engineering disciplines. One of the other things that I would add at this point that kind of reinforces what Mr. Birch said, if you examine the dynamics of the labor market as he has examined the dynamics of creation of jobs through individual firms, you find that there is an enormous ability of the work force to transfer from one skill to another. The idea that an individual is trained, he enters a job and stays at an occupation during his work life is just not reinforced by the dynamics of the work flow. And even if you take technical areas such as engineers, if you look at a cross section of engineers employed in any one year, you would think that they would all be made up of college graduates in that engineering discipline, in fact, they are not. In many cases, maybe only half of them have degrees in the engineering discipline in which they are working. Others may have degrees in other engineering fields; some may be engineering technicians that have been upgraded to engineers; others may be transferred in from related fields—mathematics, physics, and other such disciplines. So that the idea that we train in one field and stay there is just not reinforced by the dynamics of the work force and how mobile workers in this country are, not only geographically, but mobile in terms of the skills they have. Now, there are, of course, limits to mobility. You cannot jump from being a truck driver to being a nuclear physicist, so there has to be some compatibility in terms of the direction in which you are being mobile.

Other areas that we have examined in detail include the teaching field. We continue to see an oversupply of teachers, particularly at the secondary school level, because the demographic changes show that there will be a very large oversupply of secondary school teachers throughout this entire decade—although it is interesting that individual teaching specialties, such as mathematics, special education, are in short supply even with this large oversupply of secondary school teachers. Elementary school teachers, because the number of births has begun to increase and beginning about 1985 there will be a somewhat larger group entering elementary school. Consequently, the demand for elementary school teachers probably should turn around about mid-decade. At the college level, of course, the demography affects them in such a way that the demand for college teachers will be very low throughout the entire decade, and with secondary teachers, the job prospect for college teachers is one of the poorest of all the areas that we have examined. However, again, there are certain disciplines where there are not enough college teachers, namely, some of the engineering schools have difficulty recruiting teachers in the engineering disciplines because the teachers are hired by industry for their engineering skills. This phenomenon is particularly true in the computer sciences, because it is very difficult to maintain a faculty to teach computer skills when they are constantly hired away by the computer firms.

We think the health field will come closer into balance in the 1980's with the exception of nurses, which will continue to be in very high demand.

Computer specialties, I have mentioned. Only about 8 to 10 percent of the demand for computer technicians and computer specialists is met by people getting degrees in that field; the other 90 percent of the jobs are being filled from other disciplines and other skills, currently. And that will probably continue throughout the remainder of this decade.

Offsetting this are graduates in fields like arts, humanities, history, some of the social sciences, where there is a great oversupply. In my testimony I relate about a dean of a university mentioning to me about an opening for two faculty members in humanities and getting 5,000 applications for these two jobs. This serves to illustrate the tremendous imbalances that are present in the economy in terms of the training and skill that people are getting and what is required by the available jobs.

We have also examined in some detail one other field that does not require a college degree, and that is the machinist area, because that has been a job category that has been widely reported in great shortage. In fact, there are reports quoting a need for 250,000 new machinists by 1985. Our detailed examination of this reported shortage found that this number is greatly exaggerated, although there is a shortage of trained machinists today. Employers would currently hire more trained and skilled machinists, if they could, but the shortage does not reach anything even approaching the 250,000 shortage that has been forecast. Plus, in our examination and review we found that technology is replacing the demand for skilled machinists with the demand for a worker with different skills. As we introduce robotics and other computer-driven machine tools, the amount of skill required to operate these machines will get less rather than more over time.

So that even though we feel there is currently a shortage of skilled machinists, we do not see it getting any worse throughout this decade, because we expected that technology will alleviate this problem to some extent.

Finally, in looking at this skill balance, are we facing a great new trend or a great new wave? It is interesting to harken back to the late fifties and sixties, when there was an automation scare, and in that period there were Presidential commissions and others to study the impact of automation on the work force. Also during that period the workerless factory was forecast and the fact that we would no longer have a need for workers. So that in one sense, I think the trends may not be new; they may come in a wave, and the conserns about them may also come in cycles. Partly, therefore, the scares that are being raised may be old scares. But that does not negate the very large skill imbalances that we have in our economy right now that I have described and which I think we need to be concerned with and address in the future.

Thank you.

[The prepared statement of Mr. Kutscher follows:]

Testimony Before the Senate Subcommittee
on Employment and Productivity
March 26, 1982
by
Ronald E. Kutscher
Assistant Commissioner
Office of Economic Growth and
Employment Projections
Bureau of Labor Statistics

Mr. Chairman, Members of the Subcommittee, I am very pleased to have this opportunity to testify before the Senate Subcommittee on Employment and Productivity. The issues which you are raising in these hearings on declining productivity growth rates and the causes associated with them are very important and their resolution is essential to the long-run future of the U.S. economy. In your request to me to appear before this Subcommittee you asked me to discuss evidence of current or future skill "shortages" and "surpluses" and to compare the different economic sectors of the economy.

It is, of course, an irony in an economy with an unemployment rate currently at 8.8 percent, that the issue of skill shortages is even discussed. Thus, though over 9.5 million people are unemployed currently, the demand for certain skills such as computer-related skills, is growing very rapidly and the supply of university graduates with degrees in computer science is providing less than 10 percent of the current demand for the individuals trained in computer-related occupations. Similarly, although there is a projected oversupply of secondary school teachers during the 1980's, some specialties such as mathematics teachers in secondary schools are reported to be in short supply--at least in some geographical areas.

In my testimony I will discuss different meanings the term shortage has as a helpful way of focusing the discussion. Secondly, I will discuss the projections of the Bureau of Labor Statistics (BLS) that pertain to the Subcommittee's concerns. Next, I will discuss the college graduate picture for the decade ahead. Finally, I will summarize some recent work that we have undertaken on current and prospective shortage of machinists.

What is a Shortage?

One of the issues that I was asked to stress in my testimony before the Subcommittee was occupational shortages. Identifying shortage occupations is important to our society because future employment opportunities are very likely to be high in those job categories. It is also important because the immigration laws make special provisions for people possessing skills designated as scarce. Therefore, to define shortage occupations is very important.

Some specific examples may be helpful to illustrate how the definition of "shortage occupation" can imply different things in different contexts. Consider the oft-cited need for more auto mechanics. However, the number of mechanics needed and the number of workers identifying themselves as mechanics is probably in balance; the shortage, if any, is in the number of trained mechanics. The shortage depends on the definition of the quality of the training or lack of formal training of many auto mechanics. Another illustration of the use of the term shortages is in the shortage of physicians, at least a shortage to provide adequate health care to all geographic areas including remote rural areas. Here the reference of shortage is the desire or goal of society to provide health care to all, but the cost of providing health care to widely dispersed populations makes it very costly to do so. Coupled with the issue of shortage of an occupation can be the existence of a simultaneous surplus and a shortage with physicians as a case in point. Geographic imbalances manifest themselves in reports of an emerging physician oversupply in some parts of the country coupled with continuing shortages in remote rural areas. This is coupled with an imbalance by practice specialty with a specialty such as surgery reportedly in oversupply.

There is a shortage of household servants or domestic help. A constant shortage of these workers reflects the low-status and low pay afforded this occupation and the fact that most Americans do not want to do this work; thus, the sharp declines in employment in this category despite high demand. The economic context for the term "shortage," implies employers are unable to hire more trained workers at current wages--such as is currently true for machinists. The counterpart of this is a surplus where more trained workers are willing to work at offered wages than employers currently demand. It is this economic type of shortage and surplus that I will use in my testimony today.

Defining shortage occupations is a very difficult process. Currently, no regular data are published on shortage occupations. As a consequence, many people use other data as a proxy for shortage occupations, often wrongly so. As one example, the expected growth rate in a given occupation is sometimes wrongly depicted as showing that this occupation will be in short supply. Of course, the growth in demand is one element in the determination of whether or not workers in an occupation will be in a short supply. But equally important elements in the determination of whether surplus or scarcity exists for an occupation are the sources of supply and this information can be hard to establish.

Our analyses at the Bureau of Labor Statistics show that supply of workers in an occupation comes from many different sources. Educational institutions, whether secondary school or colleges, represent an important source of supply for many occupations. However, recent research at BLS on labor market flows suggests that in relatively few occupations are new graduates the predominant source of supply. In nursing, for example, recent graduates of basic nursing education programs filled fewer than half of the openings for registered nurses in 1980. The remainder came from the large pool of RN's who maintained their licensure while staying at home to care for families or--more rarely--while working in other occupations. Other important sources, however, are immigrants which are important for at least some occupations; individuals who have the requisite skill but are temporarily not working generally because of family responsibilities or because they are unemployed, but who can move into the occupation if the demand is sufficient. Individuals trained in an occupation requiring similar skills where the overlap with another occupation is high is also another source of supply. For some occupations training in the Armed Services is an important source of supply.

Information compiled at BLS on demand for a given occupation, both current and projected, is reasonably well-developed at this point and of improving quality, we hope. Our information on sources of supply, however, is very sketchy and has many gaps in it. As a consequence, in defining shortages, a great many judgments and inferences must be made based on this very incomplete supply picture.

Often what is reported as a shortage occupation may represent only changes in employer hiring preferences and these preferences can vary with the state of the market. In seeking out workers for an occupation such as electrical engineer or accountant, employers probably have a fairly well-defined hiring preference which may begin with the top graduates from well-thought-of educational institutions. From there their hiring preference would no doubt move into top graduates from lesser institutions and from there to those who finish lower down in their graduating class. Employers might then turn to individuals who have past experience in the occupation, preferably recent experience; and finally to individuals who have skills in related occupations which can be easily adapted to the occupation in demand. Thus, what might be described by employers as shortages may only mean that they are moving down their preference curve of who they would like to hire. From one viewpoint one might say that there really is not a shortage--at least in the number of individuals who could conceivably fill the position. However, from an employer's perspective, there may not be enough workers with the quality of training desired.

Although little is known about the impact of the employer's inability to hire individuals with the exact training and/or experience desired, it seems reasonable to assume that higher costs of operating and/or lower productivity gain could be likely consequences.

Also, how does the problem of shortages or surpluses get addressed? There are no simple answers here although better education planning and career guidance might help. One of the programs at the Bureau of Labor Statistics--the projections program including the Occupational Outlook Handbook--is designed to meet at least some of these needs.

BLS Projections Program

BLS regularly prepares ten-year projections of the U.S. economy. This projection program has a number of distinct dimensions: (1) We develop projections of the size of the U.S. labor force 5/10/15 years ahead and break that down by age, sex, and race, (2) We develop several alternative economic projections of courses that the economy might take over the next 10 years, (3) We use the economic projections and the labor force projections to develop employment projections by industry, and (4) The employment projections are translated into occupational demand projections for the period ten years ahead.

These data are used in career guidance, in planning education and training programs, and in analyzing the skill implications of Federal initiatives. Other uses of the projections data relate to market research, corporate planning, personnel policies, and expansion plans. Projections data also are used in economic and social research conducted by Federal, academic, and private organizations in a variety of economic and social analyses. These data are in turn used in preparing the Bureau's biennially published Occupational Outlook Handbook. The Handbook describes expected demand conditions for each of about 200 occupations and, wherever possible, makes judgments about likely supply conditions to help individuals judge the employment prospect in a career.

I would like to use these BLS projections as a framework for discussing occupations likely to be in greatest demand and to the extent possible, make inferences about supply conditions for those occupations. Also, I will note occupations where supply is likely to continue to outrun demand.

Briefly, let's take a quick look at the size and composition of the labor force. Because of past changes in the birthrate--namely the decline in the birthrate beginning about 1960, the number of individuals entering the labor force is expected to increase at decreasing rates of growth in the 1980's. As a result, the age of the labor force will begin moving up, since young people are expected to decline in absolute numbers throughout the 1980's. Women, because of their increasing participation in the labor force, are expected to account for two out of three net additions to the labor force in the 1980's. Blacks and other races, whose birthrates did not decline as soon as the white's, will as a consequence be entering the labor force in numbers greater than they represent in the total population during the 1980's. In fact, blacks who made up one out of seven net new additions to the labor force in the 1970's will represent at least one out of five net new additions to the labor force in the 1980's. (For more detail see the Monthly Labor Review, December 1980.)

BLS projections that deal with industries can be quite useful. These estimates and their underlying data bases are used by Federal agencies in preparing employment analyses, or as a framework for more detailed models of particular interest to their departments. State and local governments, area planning councils, corporations, outside research organizations, and universities also use the BLS data for planning purposes, as input to more specific models by locality or industry, or as a means to evaluate projections developed by themselves or by others.

BLS developed three alternative projections each with variations in underlying economic and demographic assumptions. However, a number of conclusions carry through all of the alternatives. For example, looking at employment prospects by industry, the following industries were projected to be among those with the most rapidly growing rate of employment during the 1980's: (1) other medical services (covers nursing homes, medical laboratories and related medical facilities), (2) typewriter and other office equipment manufacturing, (3) computers and peripheral equipment manufacturing, (4) coal mining, (5) hospitals, (6) crude petroleum and natural gas extraction, and (7) doctors and dentists offices. From a somewhat different perspective, we have isolated those industries that are expected to show the largest numerical job gain over this decade. In order, these are: (1) eating and drinking places, (2) retail trade other than eating and drinking places, (3) hospitals, and (4) miscellaneous business services (covers such activities as accounting, computer software firms, and tax preparation). At the other end of the spectrum industries which are expected to have the sharpest rate of job decline over this decade included: (1) dairy and poultry products, at the farm level, (2) alcoholic beverages, (3) leather tanning, (4) logging, and (5) synthetic fibers. (For more detail see the Monthly Labor Review, August 1981.)

The individual occupations can also be isolated in the BLS projections in somewhat the same way that I have just done for industries; namely, those expected to show the highest rate of growth and those expected to show the largest numerical gain over the 1980's. When that is done, the following occupations are highlighted. (For more detail see Occupational Outlook Quarterly, Winter 1981, and Spring 1982 available in May.)

Table 1
Occupations With Most Growth in Number of Jobs
1980-90

Occupation	Projected Growth 1980-90 (Thousands)
Secretaries	700
Nurses aides and orderlies	508
Janitors and sextons	501
Sales clerks	479
Cashiers	452
Professional nurses	437
Truck drivers	415
Food service workers, fast food restaurants	400
General clerks, office	377
Waiters and waitresses	360
Elementary school teachers	251
Kitchen helpers	231
Accountants and auditors	221
Helpers, trades	212
Automotive mechanics	206
Blue-collar worker supervisors	206
Typists	187
Licensed practical nurses	185
Carpenters	173
Bookkeepers, hand	167

Table 2
Occupations With Fastest Rate of Growth
1980-90

Occupation	Percent Growth 1980-90
Paralegal personnel	108.9
Data processing machine mechanics	93.2
Computer operators	71.6
Computer systems analysts	67.8
Office machine and cash register servicers	59.8
Physical therapists	50.9
Food service workers, fast food restaurants	49.6
Computer programmers	48.9
Tax preparers	48.6
Employment interviewers	47.0
Speech and hearing clinicians	46.6
Correction officials and jailers	46.5
Peripheral EDP equipment operators	44.0
Aero-astronautic engineers	43.4
Travel agents and accommodations appraisers	43.4
Nurses aides and orderlies	43.2
Claims examiners, insurance	43.0
Economists	42.0
Brickmasons	40.2
Psychiatric aides	39.9

College Graduates

Projections I have described to this stage, of course, emphasize only the expected demand for workers either from an industrial or from an occupational perspective. However, as noted earlier, it is necessary to go beyond the expected change in demand to look at shortages or surpluses among occupations. In doing this I will focus first on a group of occupations which normally require a college degree.

Because of the very large increase in the birth rate in the United States between 1946 and 1960, our colleges have had a dramatic increase in enrollments. Therefore, large numbers of people graduated from college in the 1970's and will continue to do so in the early 1980's. In fact, so many graduated that the job market in the 1970's could not absorb them all—at least in jobs regularly requiring a college degree. Our data show that at least 1 out of 5 college graduates who entered the labor force in the 1970's took a job not normally requiring a college degree for entry. Parenthetically, these mismatches could have contributed another element which, while not easily quantified, may have added to a decade of slowing productivity growth, even though one would normally associate more education and skill with productivity. Clearly, placing individuals with an education higher than required to perform a job could at some stage have an offsetting or negative effect because of worker discontent.

Between 1970 and 1980, the proportion of college graduates employed in professional and technical jobs dropped dramatically, from 67 percent to 55 percent, while it increased only slightly in managerial and certain types of sales jobs, groups that have traditionally employed significant numbers of graduates. The most striking change, however, was the increase in the proportion of college educated workers employed in occupations that have not traditionally required a college education—in retail sales, clerical, blue collar and service jobs. During the 1970's the proportion of workers employed in these occupations who were college graduates nearly doubled.

The BLS projections show a similar pattern continuing into the 1980's as the number of people obtaining a college degree continues to be greater than the job market can absorb. It is important to point out, however, that college graduates might not have high unemployment rates because they will win jobs in the competition with workers who do not have a college degree. Thus, they are not likely to end up unemployed, but would end up in jobs more typically filled by someone not having a college degree.

Growth in the demand for college graduates is primarily the result of growth of those occupations that require a substantial proportion of workers with college degrees, such as professional and technical occupations. In addition, many college graduates enter such occupations each year to replace workers who retire or leave the labor force, return to school, or take on family responsibilities.

Educational upgrading is a second source of growth in demand for college graduates. This occurs when the amount of education required to enter an occupation increases over time as the work and the skills required to perform it become more complex. Employers then begin to seek college graduates to fill jobs not requiring a degree in the past. During the 1970's, most educational upgrading occurred in managerial and nonretail sales jobs.

College graduates entering the labor force during the 1980's are expected to encounter job market conditions very similar to those faced by entrants of the 1970's. About 15 million college graduates are projected to enter the labor force--about 60 percent are expected to be new graduates. Most of the remainder are expected to be reentrants--college-educated workers who left the labor force to raise a family, to pursue graduate education, or for other reasons.

Depending on the amount of economic growth in the economy and growth in the number of jobs usually requiring a college degree, between 12 and 13 million graduates are projected to be required during the 1980's. This would result in a surplus of between 2 and 3 million graduates during the 1980's. If the economy grows as slowly as it did during the 1970's, the surplus would be the higher figure, an average annual surplus of about 300,000--about 1 graduate in 5--the same as in the 1970's. If the economy grows more rapidly than it did in the 1970's the average surplus would be about 200,000 college graduates--about 1 graduate in 7.

Even with more rapid growth, however, the job market for graduates in the 1980's is unlikely to be more favorable than in the 1970's. In 1980 a surplus of college graduates, estimated at 3.8 million, was already in the labor force, either employed in jobs that did not require their level of education, were unemployed, or had left the labor force. Of course, many of these have since begun satisfying careers in occupations that do not require 4 years of college. Others, however, can be expected to compete for jobs that more fully utilize their education. The job market will be more competitive to the extent that this pool of underemployed graduates of the 1970's competes against new graduates of the 1980's.

Like college graduates in the 1970's, future college graduates cannot be assured that they will find jobs in the occupations of their choice. Many may experience periods of unemployment, have to relocate to other areas of the country, or job-hop before finding work that satisfies them. As in the 1970's, some may have to compete with non-graduates for the more desirable jobs not previously filled by graduates, but in many cases, college graduates' additional education will prove to be an advantage.

Despite the oversupply of college graduates individual occupations can still be in need of workers. For example, computer specialists, particularly computer programmers and computer system analysts, are in a very short supply; about 8 to 10 percent of workers hired in these jobs had a college degree in that field. This shortage situation is likely to continue throughout this decade.

For other categories such as engineering, we think the supply/demand situation may improve. Enrollment in engineering schools has increased dramatically, and, as a consequence, an increasing number of engineers will be coming into the job market in the 1980's. The exception to this may be electrical and aeronautical engineers. Looking at the health fields, the past few decades have shown a very large growth in this industry and the occupations associated with it. As I noted earlier, we are still expecting rapid growth in the health services industries throughout the decade. However, with the exception of nurses, the supply/demand picture for other medical specialists, doctors and dentists, for example, may be coming into closer balance between the demand and the expected supply in the 1980's. Although, as I noted earlier, shortages will continue in some geographic locations and all medical specialties will not be in balance with some in shortage such as geriatric care and others such as surgeons in surplus.

In the field of teaching we have, of course, had a dramatic oversupply of teachers throughout most of the decade of the 1970's that has been estimated as averaging as high as 100,000 teachers above current demand annually. Secondary school teachers are expected to continue in excess throughout this decade. For elementary school teachers, the prospect by the middle of the decade is for a closer supply/demand balance because the recent upturn in births will increase the number of children entering elementary school by the mid 1980's. An overall surplus situation is expected to prevail in the college teaching ranks, inasmuch as the demographic situation facing them is for a declining enrollment. A dean of a university in the northeastern part of the country told me she had 5,000 applications for 2 openings in the Humanities Department--an anecdote pointing up the dimension of the imbalances facing us in some specialties. A significant portion of the oversupply of college graduates will be among those with degrees in the arts, humanities, and some of the social sciences such as history, anthropology, and sociology.

Despite the oversupply of teachers, some specialties are in demand. At the secondary level there is great demand for math teachers, teachers in special education, and teachers of bilingual education. At the college level, there is increasing concern about meeting our needs for computer-trained personnel and engineers because of shortages of teachers in these specialities. In at least some instances, the shortages exist because teaching salaries are not competitive with salaries that can be obtained by these teachers who work elsewhere.

ll of the occupations that I have just described are those in which a ollege degree is normally required in order to perform the duties. In hose occupations it is somewhat easier to get information on new sources f supply because data are available on new college degrees awarded by ield. However, when you turn your attention to other occupations not equiring a college degree, information or training becomes more sketchy. Some occupations require formal training programs or licenses and for these jobs some training information is available. But for most occupations, such data are lacking. It is lacking because a great deal of informal training takes place in private firms and in the government and this training is not captured in any of the data systems available to us. For that reason informed judgments about future supply/demand relationships for many of these occupations require an intense study of the particular occupation. Recently we have done some special analyses related to machinist occupations and I would like to summarize the results of that work for you.

Are Machinists in Short Supply?

We are presently hearing a great deal of discussion about shortages of machinists. We have examined this situation closely. We concluded that if there is a shortage in the machining occupation, it is only in the skilled category. There have been reports citing a shortage of skilled machinists totaling 250,000. In our investigation of these reports we found that they do not have a solid statistical basis. However, our investigation does indicate that there probably is a shortage of journeymen machinists at the prevailing wage. The size of that shortage cannot be precisely quantified, but we are certain it does not in any way approach the 250,000 reported by others.

In preparing this analysis, we felt it necessary to define somewhat more carefully the term "machinist." The occupations can actually be divided into two broad categories-- skilled, which includes job and die setters, tool and die makers and machinists, and semi-skilled, which includes most machine operators. Only in the skilled category was there an appreciable increase in employment throughout the past decade (Table 3). The unemployment data we analyzed reveals that the skilled machinists have had a lower unemployment rate than other occupations. For example, tool and die makers unemployment rate in 1979 was estimated at 0.9 compared to a 5.8 percent for all workers. Machinist unemployment rate in 1980 was 4.8 percent compared to a 7.1 rate for all workers.

Table 3
Employment in machining occupations
1972-80 1/

(Numbers in thousands)

Occupation	Year									Percent change 1972-80
	1972	1973	1974	1975	1976	1977	1978	1979	1980	
Skilled machining occupations, total..........	655	682	735	731	758	768	773	824	834	27
Job and die setters, metal................	94	93	97	96	92	97	98	90	91	-4
Machinists..............................	377	402	461	461	478	478	493	552	567	50
Tool and die makers.....................	184	187	177	174	188	193	182	182	176	-3
Operative machining occupations, total.......	625	595	601	489	508	524	542	562	502	-20
Drill press operatives..................	75	77	69	61	65	62	64	67	61	-19
Grinding machine operatives...............	130	140	152	132	133	126	129	143	134	3
Lathe, milling machine operatives.........	123	136	137	118	106	121	125	123	114	-7
Punch stamping press operatives...........	157	175	170	130	155	152	156	158	127	-19
Other precision machine operatives........	140	67	73	48	49	63	68	71	66	-54

1/ SOURCE: Current Population Survey, annual averages

Information about the job market for skilled machining workers during the 1970's is consistent with the existence of shortages that have been discussed in the reports described. However, statistics generated by ongoing data collection programs do not provide the information necessary to quantify the shortage. The statistics that quantify shortages are statistically unreliable and probably overstate the numerical shortage. Some employers do not experience a shortage of skilled machining workers because they offer higher than average wages and/or benefits. Also, the severity of the shortages varies among geographic areas.

Employers have dealt with shortages in many ways. Some offer wages that are higher than other employers in their locality and therefore they are able to hire the workers they need. Most employers, however, believe that raising their wages and drawing experienced workers from other firms will not solve their problems in the long run. These employers have dealt with shortages through technological improvements or by increasing training.

Those using technological development to cope with shortages have expanded their use of numerically controlled machine tools, machining centers, adaptive control, digital readout, manual data input control, improved cutting tool materials, and group technology. It is important to note, however, that technological improvements often require significant capital investment. Many small employers have great difficulty in obtaining the required funds and therefore cannot make the desired innovations.

Many employers have increased training in an effort to reduce shortage of skilled machining workers. Skilled machining workers must be trained on the job. Therefore, unless employers expand training, additional workers will not become available. Training, however is very expensive and many employers are not able to increase their training efforts to any significant extent.

General shortages of skilled machinists should not get significantly worse during the 1980's. However, it is possible for shortage conditions to become very severe in some localities.

Overview

Currently, unemployment is high, and in some occupations surpluses exist while shortages exist in others. Any policy designed to alleviate this situation must take into account the answers to the following question: What causes such imbalances? Of course, as a statistical agency our role is limited to preparing data and analyses. Policy changes, if any, which the data may seem to call for is not in the mission of the Bureau to develop or recommend. These judgments by policymakers would need to consider among other elements, some of the following.

Imbalances occur because the products made by the economy or the way in which they are made change. When changes are gradual, little imbalance results. However, when changes are sudden, imbalances occur because workers skilled at one occupation cannot find work in that field and must enter another occupation and because the educational/training system cannot adjust immediately to the new requirements of the economy. Such rapid changes can occur because national priorities change. For example, the rush to put a man on the moon greatly increased the need for workers with particular skills; upon the successful completion of that project, the need for these workers decreased and an imbalance resulted. A shift in consumer tastes can also create an imbalance, as seen in the turmoil that has resulted in the automobile industry because of changes in consumer preferences. Technological developments are a third source of change which impacts the kinds of workers required and therefore of supply/demand imbalances. If the manner in which one produces something--whether a house, a machine tool, or a computer--changes significantly, the amount and kind of labor needed for production is also likely to change.

Another question of importance to policymakers is "does the economy have the mechanism for meeting these shifting requirements?" By and large, it probably does. Declining enrollments in the humanities and rising enrollments in business and engineering schools reflect responses to the job market, at least in part. But questions should be raised as to whether this mechanism is working quickly enough. Perhaps technology is developing so rapidly that it is no longer possible to train young people for an occupation that they can hold throughout the 40 to 50 years of their worklife.

It is not easy to answer whether the skill imbalances are any greater today than they usually are. It is probably accurate to say that technology is introduced in series or waves. Therefore, the concern about technology may have a cycle about it just as other phenomena have cycles. There was a great deal of concern about the impact of the introduction of automation in the 1950's and 1960's and its resulting impact on employment in the economy. The introduction of robotics and its implication for production workers in the future is currently coming under close examination. There is also a great deal of speculation but little concrete data about the implications of word processing equipment for office and clerical employment. Will secretaries and typists disappear from the office environment or will they simply adapt to new equipment and changes in workflow? Many elements of this discussion are identical to the discussion in the 1950's and 1960's about automation replacing all workers in the factory.

One thing seems certain. We have had imbalances in supply/demand for workers in the past and we will have them in the future. We will continue to produce, unless significant changes take place, more college graduates over the next decade than there are jobs requiring a college degree. Further, this will be accompanied by shortages within the computer field and some engineering categories could see shortages. In addition, shortages of skilled machinists exist and seem likely to continue, although the degree of the shortage, is not, we believe, as great as other reports contend.

Senator QUAYLE. Let me just ask you one general question. Do you think in the future that there is going to be a demand for less people in the work force as we become more service-oriented, plus the introduction of new technology, or do you see that the new technology and the new service industry will absorb these new jobs? Do you have a projection for now until the end of the century?

Mr. KUTSCHER. Well, not to the end of the century, but for the end of the decade. There is enough likely job creation in the service-producing areas to absorb the number of individuals that will come into the work force. The problem is whether they will have the training necessary to meet the skills that are demanded, because the service sector may need accountants, and they may be releasing auto assemblers—this is a problem we have—but numerically, there is, in the service sector, enough jobs likely to open up. Another sector that I have not mentioned here is wholesale and retail trade, which employs over 20 million people. And that sector generally grows as the economy grows, so that it can absorb large numbers of people now and in the future. It is very unlikely that technology will replace the need for wholesale and retail trade.

Senator QUAYLE. Obviously, you must envision a slower technological introduction than Dr. Ansell, because in his testimony, he was quite emphatic that if this would be accepted, then you would have a large displacement of the demand for workers, hours plus numbers. So I presume in your summary, you do not see this advancement coming along as quickly.

Mr. KUTSCHER. Technology, when it is available, is not immediately adopted and disseminated throughout the economy. If you look at how technology is disseminated, you will find that the new firms, the more advanced firms, adapt that technology, and then it gradually works itself through an industry. So that the rate at which it absorbs that technology can be several decades. So that I would clearly not look for technology to be introduced at the speed which Dr. Ansell is talking about. Further, I would not envision its impact on employment to be to replace all workers as he seems to employ.

Senator QUAYLE. Thank you.

Mr. Fechter?

Mr. FECHTER. Thank you.

I appreciate the opportunity to testify before your subcommittee, Senator, and bowing to current Washington fashion, I have summarized my remarks on 3 by 5 cards. I will submit the full testimony for the record.

Senator QUAYLE. The full testimony will appear in the record.

Mr. FECHTER. As an aside, I would say as a parent with three children in college, that I sat here with chagrin listening to Mr. Kutscher tell me about the market for college graduates over the next decade, and I intend to go home tonight, call my children, and ask them to reconsider their choices.

Senator QUAYLE. Well, they need professors for engineers. There is a shortage there; that is about the only one I detected.

Mr. FECHTER. The scope of my remarks will deal with the question of dislocated workers, and most specifically, I want to talk about the question of how well we are able to anticipate the impact of technology on skill utilization and potential unemployment of these kinds of workers.

Following Mr. Jackson's remark about biotechnology and Frankenstein, I want to say that we might be able to characterize new technology as a kind of Dr. Jekyll and Mr. Hyde which on one hand, creates new jobs and requires new skills, while on the other hand, renders some old jobs obsolete. And the cause of concern is the latter effect, the effect of workers being displaced by technology and how we might deal with the very human problems that accompany those displacements. The issues that I perceive for policy formulation in dealing with programs to alleviate the effects of displaced workers are three in nature. One is how well are we able to forecast technological change—what directions are technologies going in, what kinds of technologies are we talking about. Second is how will these technologies impact on utilization of skills. And finally, and I think perhaps most important for policy formulation, how adaptable is the supply of available skills to these changes in skill utilization.

Let me now try to give you my answers to these three questions. With respect to our ability to forecast technological change, I must be a pessimist and say that we are not able to do it very well. We do not know how to measure it very well, and even with the very crude measures we have, we are not able to say exactly when technology is going to change; moreover, we are not sure how that change is going to operate in terms of its impact on requirements for inputs. Even if we know what the development process has given us in the way of new technology, we are not able to anticipate how fast it is going to be integrated into the system of our economy, and so we have a difficult time assessing its impact.

However, looking at past studies—and here, I am underscoring what other panelists have said—there is a consensus that the net effect of technology, has been to increase rather than to decrease jobs. So the Dr. Jekyll effect of technology seems to have been outweighing the Mr. Hyde effect.

It is less easy to assess how that technology is going to affect the utilization of particular skills. By and large, the state of the art in forecasting does not allow us to get at the unique effects of technology on skill utilization, so therefore, most of the forecasting models, such as the kind Mr. Kutscher has just described, generally try to anticipate the combined effects of all factors that might impact on skill utilization. So we are limited to models that do not isolate technological change as a factor.

Even those models have to be assessed in terms of their reliability. No forecasting model that exists today is perfect. Indeed, it is very possible that we can build the best forecasting model in the world and be 100 percent wrong—very precisely wrong, but nevertheless, wrong. So we need to know something about reliability. To its credit, the Bureau of Labor Statistics is one of the few organizations with forecasting that I have encountered which has put its money where its mouth is by evaluating the reliability of their earlier forecasts. They compared the 1975 forecast they made—the forecast of a post-Vietnam economy—with what actually happened in 1975. And I want to again say they are to be commended for doing this; they put their reputation as forecasters on the line despite the risk of losing credibility in the process.

Summarizing a lot of things that are in this testimony, they found that for major occupations—professional and technical workers, for example—their forecasts were within 6 percent of actual 1975 experience. At the more detailed level of occupations, however, they were less precise. Their forecast errors averaged 15 percent of actual experience. By and large the errors in their forecasts related to their inability to project the precise scenario that was going to be applied in 1975. Their unemployment assumption was not consistent with what unemployment actually was in 1975. Their assumptions about productivity change did not accord with what actually happened with productivity change up through 1975. And last but not least, their assumptions about how skill mixes were going to change were only partially adequate. They knew the direction, but they did not know the magnitude of the change that was going to take place. So they had problems, and they admitted their problems, and I salute them for their candor.

The bottom line that I would come to with respect to the ability to forecast technological change and then to forecast its implications for skill utilization is that we can probably use the forecasts from the types of models like the one BLS used for major occupation classes. They are reasonably close when it comes to this level of aggregation. We have to be more careful about how we use these models when we go down to detailed levels of occupations. Unfortunately, if we are going to talk about future programs to attenuate adverse effects of displacement I think the focus will be on these detailed categories and not on these major categories of occupations. Therefore, caution will be necessary in using these forecasts for policy guidance. To their credit, BLS is doing what I advocate in my testimony.

They are projecting to 1990 using several scenarios about the future, because they really are not able to nail these scenarios down closely. They assume different rates of growth and productivity, and they give us a range of forecasts.

I think the only way we can use those projection models is as broad planning tools. I also think we need more research to improve the capabilities of these models. We need more research in the area of what determines productivity and what determines skill mix, so that we can do better in the future. I am sure Mr. Kutscher will not disagree with me on that point.

I turn now to the question of whether we want to do something about the employment implications of technological change—is it a problem or is it not a problem? To answer this question, we need to know how the labor supply may adapt to any changes in skill requirements taking place as a result of technology or of foreign competition or any other kind of event that might cause displacement of workers. Most research that I have looked at seems to indicate that the labor market is highly adaptable, and much of the testimony we have heard today reinforces this impression of a world in which workers are adaptable, can accommodate changes in circumstances, and move on to new opportunities.

I try in my written statement to give you some idea of the magnitude of worker displacement. It is very weak evidence, but it is necessary evidence to determine how large a program you might want if you are going to develop a program for displaced workers. My assessment is based on the only measurable information we have, unemployment. The kind of unemployment I discuss is usually characterized in the literature as structural unemployment, which means unemployment arising from a mismatch between the available skills and the skills required. That kind of structural unemployment usually manifests itself in unemployment of long duration as opposed to high turnover, short duration unemployment. Thus, long duration unemployment seems to give us the first clue about how large the problem might be.

I found two studies which have dealt with this type of unemployment and I would like to give you some sense of what these two studies tell us. Before I do, though, let me qualify my remarks by saying that unemployment is only the tip of the iceberg. We also have to identify people who are not unemployed, but who may also be suffering adverse consequences from technological change; for example, people who may have dropped out of the labor force because they are discouraged from looking for work, or people who are working part time involuntarily, who would like to work full time, or people who are working at jobs that are lower in skill level than the jobs they had before. I confine my remarks only to the unemployment dimension of that problem.

One study was done by Robert E. Hall of MIT. He looked at the number of workers unemployed 14 or more weeks in 1966—a full employment year, by the way, by most people's definition. I think the unemployment rate was about 3.5 percent in 1966; we were increasing our involvement in Southeast Asia, and there was very little overall unemployment compared to historical standards. In that year, Hall found that the number of people who were unemployed for more than 14 weeks was about 500,000 individuals, less than 20 percent of all unemployment, and about 1 percent of the labor force. But we are now in the 1980 period, and it is a wholly different environment. One cannot say comfortably that the problem has not gotten worse since those days.

I found a more recent study, done under the auspices of the National Commission on Employment Policy. This study, by Bendick and Devine, tried to estimate the number of dislocated workers in 1980. As part of that exercise, they defined dislocated workers as people who were: Unemployed for at least 8 weeks and were in either declining industries—industries where employment has been going down—declining occupations—occupations where employment was going down—or declining regions—regions which were experiencing declining populations from 1970 to 1980. Using these criteria, their estimate of dislocated unemployed workers, was anywhere from 90,000 to about 250,000—using 26 weeks or more of unemployment as your definition—and anywhere from 400,000 to 900,000 using 8 or more weeks of unemployment duration as your definition. Again, these numbers are not dramatically large, but they are significant.

Bendick and Devine also found that these workers tended to be located in semi-skilled operatives in industry jobs, primarily in the Frost Belt States. They also found that these people were very well situated to absorb unemployment experiences. A very high proportion were on unemployment insurance, and were therefore protected, at least in the short run. They were likely to have other family members in the work force, so that the job loss did not mean losing all sources of earnings. Finally, they found that these people had characteristics which put them in a better position to find new jobs in the future. They tended to have higher levels of education than disadvantaged unemployed workers, and they tended to have sex and race characteristics which would handicap them less than the disadvantaged unemployed.

Let me now turn to my conclusions. I think the evidence from these two studies indicates that we do have pockets where people are having prolonged difficulty finding jobs. By and large, these pockets include workers for whom skills developed in jobs that were being lost were highly specific, so that retraining is required to get new jobs or workers in regions in which overall employment situations were not favorable, so that they could not find alternative jobs locally, or workers who were old, where old is defined as over 40 years of age. I noted on the TV the other night that the Equal Employment Opportunity Commission has recently reported a dramatic rise in the number of cases based on age discrimination in layoffs and other separations. That may be the wave of the future. We will not be able to forecast where those pockets of displacement are going to be in the future because the state of the art in forecasting models does not allow us to do so. Thus, it would be prudent to carefully monitor the characteristics of unemployed workers—particularly the long-duration unemployed—and to try to identify any hidden unemployment or underemployment that might be relevant. With the kinds of competition we are getting from abroad and the large increases in technology coming about from the computer and the biotechnology revolutions that we have heard about today, this problem could get worse in the future and I think we have to watch it very carefully to see if it does.

Thank you.

[The prepared statement of Mr. Fechter follows:]

Statement of Alan Fechter
National Science Foundation

before the

Subcommittee on Employment and Productivity
Senate Labor and Human Resources Committee
March 26, 1982

Mr. Chairman, I welcome this opportunity to participate in this panel and to provide my views on an important issue: unemployment arising from technological change. Although I focus my remarks on the impact of technology, most of what I have to say is equally relevant to the impact of foreign competition or any other cause of worker displacement.

Concern about the effect of technological change on the demand for workers has always been with us. It is based on the belief that social and economic disruption results from the displacement of workers affected by such change. It is not obvious, however, that technological change necessarily increases the amount of unemployment we face. New technology simultaneously renders some skills obsolete and generates demand for new skills. Thus, to develop sensible policy on the issue of worker displacement arising from technological change (or, for that matter, from any other factors that might change the structure of labor markets), one should have some notion of the answers to the following questions:

(1) how well are we able to forecast technological change;

(2) how well are we able to translate this change into shifts in skill utilization; and

(3) how adaptable are labor markets to these shifts.

The answers to the first two questions would give us an idea of how finely we can pinpoint skill imbalances arising from technological change. The answer to the last question provides guidance on the potential magnitude of such imbalances. The material I now turn to will hopefully illuminate these issues.

Forecasting technological change

Studies of our past economic experience indicate that, while technological change has been a major cause of economic growth, we are a long way from understanding its determinants. Factors such as firm size and market structure alone do not appear to be important as single determinants of technological progress; rather these and other factors interact in complex ways to determine research, development and innovation, the major components of technical change. Since these complex interactions are not fully understood it is small wonder that our capability to forecast technological change is limited. Moreover, the existing studies show that, even if we had some conception of what the major determining factors were, the amount of time it takes to transform a development into a new innovation varies greatly.

Even making forecasts about a specific technology is difficult. Needless to say, there is considerable room for improvement in this area. For now, available knowledge limits us to tolerable forecasts of change that have passed the development stage and are about to become innovations. Even this limited capability, however, does not allow us to accurately forecast the rate of diffusion. This rate would have a substantial impact on skill utilization.

Assessing the impact of technological change on skill demand

In principle, technological change can affect the demand for labor in offsetting ways. A technological change, by raising factor productivity, can reduce the demand for labor for a given level of output. On the other hand, by making production more efficient, technological change can permit sale of a better quality product or sale at a lower price, increasing the demand for output and, consequently, the demand for labor. While our experience is that technological change generally has, on balance, stimulated aggregate employment demand, its impact on labor disaggregated by skill is less thoroughly understood.

Models that are used to produce long-range forecasts of manpower skill requirements at the national level are usually predicated on projections of output, labor productivity, and skill mix. Technological change is but one of many factors underlying projections of skill requirements and most models do not explicitly project this change. Instead, such changes are implicit in projections that are made in variables on which technological change has a significant impact--labor productivity and the skill-mix of the work force. Projected changes in these variables, however, also reflect the impact of other variables (for example, the relative cost of energy, utilization rates of capital, skill differentials in wage rates, provisions of collective bargaining agreements, etc.). Thus, they are not able to isolate that part of the projected change--either in productivity or in skill-mix--which can be attributed to technological forces.

Given these limitations, existing skill-requirements models can not be used to develop finely-honed dissaggregated projections of changes in the mix of skills demanded due to one unique casual factor. Instead, they can be used to identify sets of skills that can be expected as a result of the combined effects of all casual factors, to experience strong growth and sets of skill that can be expected to experience slow growth.

Because of the limitations of these skill-requirements models, their application to at least some policy issues could be inappropriate, or worse, misleading. One should, in principle, have some idea of how reliable their forecasts have been before basing policy on them. The Bureau of Labor Statistics (BLS) has been one of the leading actors in developing long-range forecasts of skill requirements at the national level.

To their credit, BLS has put its reputation on the line by evaluating the performance of their model. They compare their forecasts for the year 1975 with actual experience and find that their forecasts of employment by occupation were off by an average of 6 percent for major occupations and 16 percent for detailed occupations (both expressed as absolute magnitudes). The major factors underlying the forecasting error in occupational employment were sampling errors in small occupations and failure to fully anticipate the effects of technological change. They were usually able to identify the direction of change, but not the magnitude.

Based on this analysis and related evidence, I would conclude that the BLS model can serve as a reasonable base for generating long-run forecasts of skill requirements (and the degree of worker displacement that they imply) at the national level. However, these forecasts should be presented for a set of alternative macroeconomic scenarios since they have not been very successful in accurately predicting the course of productivity (a variable that is driven in part by technological change) and unemployment. Moreover, I would suggest that further effort be devoted to attempting to understand the factors causing shifts in skill mix (also driven in part by technological change).

Efficiency in labor market adjustments to technological change

I have reviewed the ability to forecast skill requirements and the impact of technological change on these requirements and have noted that existing models can generate forecasts of total skill requirements, but can not isolate the effects of a single determinants of changes in these requirements such as technological progress. Given these models and their reliability, the question remains, however, as to whether it is appropriate and possible to develop more accurate and refined forecasts. Such improved accuracy and refinement would be necessary if our inability to accurately forecast the impact of technology on skill utilization resulted in substantial amounts of hardship arising from the inability of workers to adapt to this impact. This would be reflected as inelasticities on the supply side of the labor market in the form of labor immobility arising from its highly specific skill-content or other sources of market rigidity.

The evidence available from existing studies suggests that while labor supply is highly adaptable, pockets of inflexibility may exist. Thus, any program to alleviate the adverse consequences of worker displacement resulting from technological change (or, for that matter, any other cause of such displacement) should be targetted on these pockets.

A crude measure of adaptability to technological change is the amount of unemployment that exists in labor markets. This measure probably understates the impact of technology because it omits displaced workers who have dropped out of the labor force or who are working involuntarily in part-time or "low-skill" jobs as a result of technological change. The kind of unemployment that is produced by technological change is sometimes characterized as "structural." Structural unemployment can be characterized as long-duration unemployment.

In studying workers who are unemployed when the economy is considered to be at "full employment", Hall concludes that "...the evidence on the duration of unemployment and on individuals who are not in the labor force suggests rather strongly that chronic inability to find a job is not a problem found by a significant number of people when the economy is at full employment. The real problem is that many workers have frequent short spells of unemployment." Hall finds that only one-sixth of the unemployed in a relatively full employment period (1966) were unemployed for more than 14 weeks. Unemployment averaged roughly 2.8 million in the year of his analysis; therefore, the number of long-term unemployed ranged between approximately 470 and 700 thousand. This would suggest that long-duration unemployment was a relatively minor phenomenon in the fully-employed 1966 economy. This influence holds even more strongly for technological unemployment, which is only a subset of long-duration unemployment. However, these data provide no clues on the nature and extent of underemployment among displaced workers who were involuntarily employed part-time or who dropped out of the labor force because of inadequate job opportunities. Moreover, Hall's findings are not necessarily applicable to the post-1966 labor market.

More recent evidence for 1980, however, supports Hall's earlier findings. The National Comission on Employment Policy, drawing on the findings of a study by Marc Bendick and Judith Radinski Devine, estimates the number of "dislocated" workers in 1980. Bendick and Devine present estimates, depending on duration of unemployment and the characterization of structural decline, that range between 90,000 and 900,000. This represents at the upper range about 15 percent of the unemployed (or about one percent of the labor force) in March, 1980.

Dislocated workers were defined as those who were: (1) unemployed for more than 8 weeks; (2) were between the ages 22 and 64; and (3) had been employed in either a declining industry, a declining occupation, or a declining region. These estimates are summarized below:

	Duration of unemployment	
	More than 8 weeks	More than 26 weeks
Total "dislocated" workers in a declining:		
industry	412,000	90,000
occupation	642,000	90,000
region	895,000	269,000

Bendick and Devine found that much of this unemployment clustered among semiskilled operatives formerly employed in manufacturing industries in the Nation's "frostbelt" region. The motor vehicle industry alone accounted for 106,000 of the persons unemployed for more than 8 weeks. In fact, that industry represented the major exception to a generally optimistic picture. There, unemployment exceeding 8 weeks stood at more than 10 percent of the industry's nationwide labor force, and nearly 25 percent of all unemployed persons in the industry had been unemployed more than 26 weeks.

Bendick and Devine also found that, while association with a declining industry or occupation generally had little effect on a worker's reemployment, association with a declining region seemed to make a major negative difference. A worker living in a region with very high total unemployment could expect the average duration of unemployment to increase by more than 2 weeks; correspondingly if the region was experiencing long-term population loss, the average duration increased by 1.5 weeks. As a result, while economically declining regions accounted for 43 percent of 8-week unemployment, they accounted for a higher proportion--more than 55 percent--of 26-week unemployment. These findings are consistent with geographical immobility of labor, even in the face of large differences in economic opportunities (between, for example, Detroit and Houston).

The characteristics of the dislocated workers identified by

Bendick and Devine suggest that they are better able to cope with adverse employment circumstances than disadvantaged workers. Dislocated workers are, on average, more affluent. For example, among the 400,000 persons who were unemployed at least 8 weeks and had been working in a declining industry, nearly half were in families with incomes above $10,000 in the previous year (1979). These dislocated workers are also much more likely to be recipients of Unemployment Insurance benefits. A larger fraction have other workers in the family and a smaller fraction are receiving AFDC or other welfare payments.

In addition, dislocated workers have characteristics that are usually associated with job-finding success and are more employable than are the unemployed from low-income families. Among the workers dislocated from declining industries, for example, 66 percent were high school graduates, compared with 56 percent of comparable workers from low-income families. Moreover, 31 percent of the dislocated workers were black, Hispanic, or members of another minority group, compared with 43 percent of the low-income unemployed. A statistical analysis conducted by Bendick and Devine found no significant association between being from a declining industry (or occupation) and the duration of unemployment.

The bottom line to be drawn from these empirical studies of long-term unemployed and displaced workers is that, in the past, the magnitude of such unemployment appears to have been nontrivial, but not overwhelming. Moreover, at least in the short-run, the adverse consequences of such job loss appear to have been manageable since displaced workers were protected from the shock by Unemployment Insurance and the presence of other family members in the work force. Finally, displaced workers did not seem to be heavily burdened by labor market handicaps and thus were likely to be able to secure new employment without major difficulties. This does not mean, however, that there may not be some groups of workers who may experience significant difficulties or workers who find jobs, but at a substantially lower wages.

It should be noted, however, that structural shifts in the labor force--in particular the significant increase in its average age expected in the 1980's--may be emerging that can result in reduced labor market adaptability. Thus, adjustments to structural factors such as new technologies may become more difficult. For example, we are beginning to observe the effects of technologies developed as part of the computer revolution. This technology is replacing: workers on the assembly line with robots; technicians with computer-aided design equipment; and clerks and other white collar workers with tabulations, computations and analyses generated by computers. It is too soon to assess with certainty the implications of these changes. But, it is possible that we may witness a rise in the incidence and prevalence of worker displacement in the 1980's. Thus, I would advise that the situation be monitored closely so that the appropriate action can be taken quickly if such an increase emerges.

References

1. Marc Bendick, Jr. and Judith Radlinsky Devine, "Worker Dislocated by Economic Change: Do They Need Federal Employment and Training Assistance," The Federal Interest in Employment and Training, Seventh Annual Report of the National Commission for Employment Policy, pp. 175-226.

2. Alan Fechter, Forecasting the Impact of Technological Change on Manpower Utilization and Displacement, (Urban Institute Report No. 1215-1), March, 1974.

3. Robert E. Hall, "Why is the Unemployment Rate So High at Full Employment?" Brookings Papers on Economic Activity, 3:1970, pp. 369-410.

Senator **Quayle**. Mr. Fechter, despite the success of BLS, do you believe that there should be more of a national attention to the translation of technological changes and how we are going to utilize skills and the availability of skills? Do you believe, as some of the other witnesses have talked about, that we are in this transitory society, and there is going to have to be more input from the Federal level?

Mr. **Fechter**. Let me say before I answer that my answer to that question on the basis of my personal views, and these views do not represent those of the administration or the National Science Foundation.

Senator **Quayle**. Thank you very much. We have heard that statement quite frequently throughout these hearings. We appreciate it, and we know exactly what you mean, too. Now we will find out what the true story is.

Mr. **Fechter**. Having said that, I do believe we should, but this input should be modest, since the magnitude of the problem does not appear to be large. However, there are enough signals out there to suggest that we ought to be hoisting storm warnings about this issue over the next 10 years. For example, the employment impact of foreign competition and new technologies, particularly those related to the computer may create increasing problems at all skilled levels. We are currently seeing an increase in the use of computer-aided design and computer-aided manufacturing that could, in fact, cause displacement among electrical engineers. The problem will not necessarily be one that is located or focused on any particular skill or region. Now, it is very possible that those displaced engineers will have no problem finding jobs, but we should know that so that we can take appropriate steps if the situation calls for such steps. On the basis of the current state of the art, I am not optimistic, that the forecasting models we have now are up to the task at the level of detail that will be necessary. So I think we need to do a number of things. We have to try to improve those models and their reliability. At the same time, in case a problem does come along, we have to use current unemployment and underemployment information to track trends in the characteristics of the unemployed as we see them developing.

Senator **Quayle**. Well, this has been very exciting testimony. Both panels have been very specific in their recommendations, and it has certainly been enlightening for me.

I have just one final parochial question for Mr. Birch. What kind of suggestion would you have to my industrial State of Indiana, which has a very high rate of unemployment, to move more toward service-related industry as you discussed with Massachusetts and Connecticut, who have already gone through this transition. Do you have any remedial advice to States like mine, or Michigan, that are finding themselves in this chronic unemployed situation? It is not new for us. We have had it for the last 5 or 6 years.

Mr. **Birch**. I was speaking with the Governors of Minnesota, Michigan, and Wisconsin recently on this subject. I think it is a general awareness of what is happening, first; to realize, say, in Michigan, that you have lost 135,000 manufacturing jobs and gained 450,000 service jobs—most people in Michigan did not know that. They did not realize that in, fact, there was a tremendous revolution going on in the structure of the Michigan economy which was swamped by the automobile crisis. And I think once you learn that, the first thing you do is you never replicate a St. Louis school system. You, at a minimum, have one computer terminal at every school. I mean, you begin to adjust your educational systems so you put out and do not get into all of the things that have been said here, so that you begin to produce a product that is compatible with the environment that you are creating for that product, rather than still teaching people how to run lathes when there are very few left. I think those kinds of things, looking at the educational system and matching it to what the jobs will be like in the future, would be a major step that a State, at the State level, would deal with. I think it would be very important, and if I had to focus on one, that is the one I would focus on.

By the way, just one final comment. I think George Ansell is right in the long run. I think, as I wander around the AI labs, the artificial intelligence laboratories, at MIT, I see everything he is saying unfolding in those laboratories. I think there will be a 15- or 20- or 30-year period where we can scurry around the world, exporting the intelligence that we are creating, and that seems to be what we are doing. I think there will come a time when we will pay the fiddler for what is happening. And I would just for the record concur with what he said.

Senator **Quayle**. In other words, you say we are going to be exporting rather than, perhaps, implementing——

Mr. **Birch**. We will implement ourselves, and then we will keep ourselves busy exporting that implementation all over the world, which is what we are now doing. We export services more than anything else, practically, at this point, and services are really the kind of intelligence that he is talking about.

I guess the only difference I would have, would be I think it will be a while before we run out of that game. It may be 15, 20 or 30 years. Sooner or later, I think we will come to face the reality that he described, though.

Senator **Quayle**. Do you think it has a potential of boomeranging on us, in the fact that by exporting the services, eventually, we may lose some of our competitive advantages that we have right now?

Mr. **Birch**. We have had a history of doing that in the past, and I suspect that could well happen again. And in fact, one of the things we should consider but probably will not is just how much of our intelligence should we export. We have historically given it away almost free, and that raises a serious question about losing our competitive advantage in this next level of activity.

Senator **Quayle**. Again, thank you very much.

The committee will adjourn until April 2, next Friday.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned, to reconvene Friday, April 2, 1982.]

PRODUCTIVITY IN THE AMERICAN ECONOMY, 1982

FRIDAY, APRIL 2, 1982

U.S. Senate,
Subcommittee on Employment and Productivity,
Committee on Labor and Human Resources,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:23 a.m., in room 4232, Dirksen Senate Office Building, Senator Dan Quayle (chairman of the subcommittee) presiding.

Present: Senators Quayle and Hawkins.

Opening Statement of Senator Quayle

Senator Quayle. The committee will come to order.

This morning we continue with our series of hearings examining the productivity problem our country faces. Today we will focus on what exactly productivity is, how the term should be defined, what the implications are for international competitiveness, and what incentives may be needed to help labor and management increase productivity.

Last week our panelists discussed the impact of new technologies on labor productivity and the affect these new technologies are having on the employment and training needs of our populace.

We were advised that we as a nation must prepare to address the changes in our work force that will come from adoption of new intelligent technologies. For example, by 1990 the estimated installation rate of new robots in the United States is forecasted to be approximately 31,000 a year.

Today, robots weld, work on assembly lines, pour in foundries, and load machines. As we move toward a more automated work force, workers will continue to be displaced in greater and greater numbers.

Among the recommendations made to our subcommittee for dealing with this growing problem are that:

We must educate a new generation of engineers and technologists to design, build, and maintain these new complex manufacturing systems.

We must address the dislocations in the manufacturing labor force that will follow the movements toward the factory of the future.

In order to fully exploit this new technology, we must develop new partnerships between industry, government, and the university sector.

On another front, these hearings have reminded us that international competitiveness will be affected dramatically by new technology. Clearly these new technologies are critical to the health of the American economy and to American industry. For us to be competitive internationally, our employment and training needs must keep pace with the new technologies evolving in productivity.

Exports now account for approximately 7.5 percent of our GNP and 17.3 percent of all final sales of U.S. goods. This figure is nearly double what it was in 1970. Imports have also doubled during this time to 9.2 percent of our GNP and 21.2 percent of final sales.

Therefore, a key question for the subcommittee is what can and should we expect in the future from international markets as far as their being a source of growth for U.S. labor and jobs. This question is also closely tied to what we accomplish now and in the future in developing advanced technologies. At this point, it is interesting to note that while we had a trade deficit of $30 billion in 1978 for low-technology goods, we had a positive contribution of $40 billion from our trade in R. & D. intensive manufactured goods.

We have asked our panelists today to characterize some of the implications we face if our productivity continues to slide. We also want to hear what the Federal Government can and should be doing, or perhaps not doing, to promote productivity.

The United States needs to stay in the lead in technological developments in those sectors which are in the vanguard of the expansion of production and trade. Yet we cannot rely on Government to rescue us from our plight of low productivity. Government can be the catalyst we need for constructive change, but there must be others actively involved. We must demand more from the leaders and the institutions of labor and business. We have much to learn from our friends in other countries who have creative solutions to productivity problems, especially Japan, which is now in the forefront in this area.

Our first panel is devoted to describing productivity, how it is measured, and how it varies by economic sectors.

As the two panel members, we have Mr. Albert Rees, president of the Alfred P. Sloan Foundation; and Frank M. Gollop, from Boston College.

Mr. Rees.

STATEMENTS OF ALBERT REES, PRESIDENT, ALFRED P. SLOAN FOUNDATION; AND FRANK M. GOLLOP, ASSOCIATE PROFESSOR, BOSTON COLLEGE, CHESTNUT HILL, MASS.

Mr. REES. Thank you, Senator.

It is a pleasure to be here this morning to discuss productivity measurement. In the broadest sense of the term, a productivity measure is any ratio of an output to one or more of the inputs that produce this output. Thus, miles per gallon of gasoline is one measure of the productivity of an automobile, bushels per acre is one measure of the productivity of a cornfield, and tons per worker shift is one measure of the productivity of a coal mine. Each of these measures tells us something about the efficiency with which one input is used to produce a particular output. No such productivity ratio has much meaning standing by itself, we are generally interested in changes in productivity through time, or in comparisons of productivity among places.

The most widely used and broadest measure of the productivity of the American economy is output per hour of all persons engaged in the private business sector, a measure issued quarterly by the U.S. Bureau of Labor Statistics. Such a broad measure cannot be stated in natural units of output such as tons of coal or bushels of corn. The basic output measure must be dollar value, which is reduced to real or constant dollars by deflating it by appropriate price indexes. In constructing the series on output per hour in the private business sector, BLS uses current dollar measures of the output of the private business sector, excluding owner-occupied housing, from the national income and product accounts of the Bureau of Economic Analysis. The price indexes used to deflate these current dollar outputs come largely from the BLS Producer Price Index and Consumer Price Index. The labor input data come for the most part from the BLS current employment statistics based on monthly establishment reports. Where employment or hours data from establishments are not available, household data from the Current Population Survey are used.

Measures of productivity that use hours of labor as the denominator of the productivity ratio are known as labor productivity measures. Of course, the changes in such measures do not necessarily reflect any change in the quality of the labor input. Output per hour of work could rise because workers were becoming more skilled or experienced, or were working harder. But such a measure is more likely to rise because of technological change or because workers have been provided with more capital to work with. Conversely, a fall in output per hour of work does not indicate that workers are losing their skills or becoming lazy. It is more likely to occur because output is falling, and employers cannot reduce labor inputs correspondingly.

For many years, private economists have been using a different kind of productivity measure, the ratio of output to a weighted combination of labor and capital inputs. Such measures are usually called measures of total factor productivity. Professor Gollop is going to use the term "multifactor productivity" to describe the measure that I am calling total factor productivity. I am sorry if this creates any confusion. He has a different measure which he is going to call total factor productivity.

The measure that I call total factor productivity, output per unit of combined labor and capital input, comes closer than measures of labor productivity to measuring the efficiency with which all inputs are used. Although the Federal Government does not produce such measures, one is presented in the Economic Report of the President for February 1982; you will find it in a table on page 113. As far as I know, that is the first time that a total factor productivity measure has been cited in a Federal Government publication.

Over long periods, capital per unit of labor has been increasing, and therefore the increase in total factor productivity measures is smaller than the increase in labor productivity measures. Over recent years, however, trends in the two kinds of measures have been quite similar.

As you all know, the productivity of the American private economy as measured by any of the accepted measures, has not been growing much in recent years. From 1947 through 1967, output per hour of work in the private business sector grew at more than 3 percent a year. From 1967 to 1972 this growth slowed to about 2 percent a year, and from 1972 to 1977 to just over 1 percent a year. Since 1977, the record has been even worse. In 3 of the 4 years, 1978 through 1981, productivity declined, that is; output rose less than the hours of work used to produce it. This slowdown in productivity growth is of very serious concern because in the long run productivity growth is the source of the increase in the standard of living of our entire population.

One may ask to what extent this alarming slowdown in measured productivity growth could be the result of measurement errors. In 1978–79, I chaired a panel of the National Research Council that reviewed the measurement of productivity with great care. My conclusion from this experience is that measurement errors do not account to any appreciable extent for the recent slowdown of productivity growth.

This conclusion does not assert that productivity is measured without error. There is clearly error, and some of it is important. For example, we measure the labor input of employees by the number of hours paid for, including hours of paid vacation, holiday, and sick leave. It would be far better to measure the hours that workers actually spend at the workplace. Since hours of paid leave have been increasing as a proportion of total hours, the use of all hours paid for as a measure of labor input understates the growth of productivity per hour of work.

As another example, on the output side, we lack good price measures for some high technology products such as computers, the price of whose services has been falling rapidly. Deflating the current dollar output of the computer industry by an inappropriate price index understates the growth of real output, and hence the growth of productivity.

The common feature of these and several other identifiable sources of measurement error is that they bias our productivity measures downward. But these sources of error have existed throughout the postwar period, and are in general less serious now than they were in earlier years. When a downward-biasing measurement error is becoming smaller, this means that a more accurate productivity measure would show an even larger retardation in growth than the measures we have been using.

There is one kind of measurement error that might be contributing to the lag in measured productivity growth in retailing and the services industries. This error could arise from an increased tendency for small businesses not to report their full receipts—that is, for owners to skim cash from their businesses in order to evade taxes. In such cases, all of the labor input would be recorded, and part of the output would not. Note that if the entire enterprise is outside the legal economy, if it is entirely underground and reports neither inputs nor outputs, it does not enter the productivity measures at all. The underreporting of receipts is unlikely to be important in measuring productivity in such sectors as manufacturing and mining, where most output is produced by large enterprises with good financial controls.

If measurement error is not the probable cause of the slowdown in productivity growth, what is? That is a much more difficult question, to which there are many answers, none entirely adequate. I leave that question to the other witnesses this morning.

The panel to review productivity statistics of the National Research Council made a large number of recommendations for the improvement of productivity measurement. I recognize that in the present budgetary situation, most of these are not likely to be implemented. There is one, however, that could be implemented at a trivial cost because all the data needed are already collected. This is a recommendation that the Government produce and publish an official index of total factor productivity. Beyond this, I would remind the subcommittee that productivity measurement makes use of almost every part of the total system of Federal economic statistics. To allow this system to deteriorate through budget cuts would increase the errors in productivity measurement. This would make it even harder to diagnose the difficulties our economy faces and to find effective remedies for them.

Thank you.

Senator QUAYLE. Thank you very much, Mr. Rees.

Mr. Gollop.

Mr. GOLLOP. Thank you, Senator.

I am pleased to have this opportunity to share in this discussion of productivity, by evaluating how well an economy or an individual business transfers input into output.

Productivity is perhaps one of the best single measures of economic performance. What I would like to do is submit the statement I prepared formally to the committee, and now just highlight the important points.

Senator QUAYLE. The full text of your testimony will be submitted for the record.

Mr. GOLLOP. Thank you, Mr. Chairman.

What I would like to do is focus on two things. For a few moments I would like to address some fundamental issues in productivity measurement. I hope to convince you that economic principles suggest that a total factor productivity framework offers the most meaningful measure of productivity growth.

Then I would like to discuss results of economic research applying total factor productivity to the study of aggregate and sectoral productivity growth in the postwar United States.

As Dr. Rees has pointed out, output per hour worked, or labor productivity, is the traditional productivity measure. But in the fifties economists began to realize the capital intensive nature of our economy. The measure of productivity growth had to shift. It had to include not only labor input but capital input as well. That is what I would call a multifactor measure—or what Professor Rees labeled a total factor productivity measure.

But then the past decade gave us another signal. Energy and material inputs no longer could be ignored. Evaluation had to shift from looking simply at the aggregate economy to what is going on in individual sectors, and it is at that point that a measure of what I would call total factor productivity evolved.

Labor productivity is measured as the growth in output unexplained by the growth in labor input.

In polar contrast, the growth in total factor productivity is defined as the growth in output unexplained by the growth in labor, capital, material, and energy inputs. The important question is: which model offers the most meaningful advice? The answer, I believe, comes right out of economic principles.

Productivity growth, recall, is a measure of economic performance. The role of any economic performance measure is to serve as a barometer, sensitive to the economy's success in solving its economic problem: the allocation of scarce resources to satisfy human wants. What makes this problem an economic one is scarcity, a concept no more appropriate to labor than to capital, energy, or material inputs.

In short, the efficient solution to society's economic problem involves all inputs. A well defined index of productivity growth must look at all scarce resources. This principle has important implications for measuring productivity growth at both aggregate and sectoral levels.

Consider the macroeconomy, the Nation as a whole. The relevant inputs in measuring output at that level are simply labor and capital. Transactions in intermediate inputs cancel out. For example, sectoral deliveries to intermediate demand, the steel produced for the automobile industry, and intermediate input purchases, steel consumed by the automobile industry, are self-canceling transactions within the macroeconomy.

In contrast, studies of firm or sectoral productivity must include all labor, capital, and material inputs, including energy. After all, steel input to the automobile industry is as important an input as is labor and capital to the automobile industry.

Moreover, these inputs are not unimportant. Even before energy prices began to skyrocket, in U.S. manufacturing, materials accounted for 65 percent of input costs. Given market prices, a firm chooses a particular combination of capital, labor, material, and energy inputs.

Now, the importance of including material inputs in a measure of sectoral productivity is easy to understand. Consider a supermarket manager. A supermarket manager can make a simple choice. He can choose to have his own employee display frozen ice cream products in the frozen foods cabinet, or he can contract with the raw materials supplier to have its delivery person display the product. The former is a direct labor cost to the supermarket; the latter is an expense related to material input.

Now, the supermarket manager makes that choice on the basis of the relative productivities and prices of his own employee and the delivery person. Let us take an example. Let us assume that the supermarket manager first uses the delivery person. Then after a while he discovers that his employee can do it at a lower cost. The manager will now substitute his own employee for the truck driver.

What has happened? Real productivity, from the point of view of the manager, has increased, has really increased, and yet output per man-hour has what? For the supermarket, it has gone down.

My problem with labor productivity measures unless supported by lots of other evidence, is that they are excluding in this example material inputs from the measure of productivity growth. This not only presents a distorted characterization of the manager's rational behavior but also may bias any subsequent analysis of the trend and sources of the industry's productivity growth.

Recent events in the last decade have impressed us with the importance of those microeconomic foundations of aggregate productivity performance. The economy does not consist of horizontally independent sectors. Only the total factor productivity measure accounts for those important linkages between sectors. Only it describes how an individual sector transmits the benefits of its productivity growth to final consumers, both directly through deliveries to final demand and indirectly through deliveries to intermediate demand.

So if productivity measures are to serve as meaningful barometers of society's success in solving its economic problem, then neither material inputs nor intersectoral linkages can be ignored.

With that introduction, I would like to focus on some results, and you have in front of you table 1, as I comment for the next couple of minutes.

The U.S. economy experienced rapid economic growth over the early postwar period. The rate of economic growth peaked during the period 1960 to 1966. Growth rates slowed substantially between 1966 and 1973, and have fallen to disappointingly low levels since then.

Analysis of the slowdown begins with the decomposition of the growth of output during the postwar period into its source components.

Now, recall, we are now looking at the aggregate economy, so at this level we need only concern ourselves with labor and capital inputs.

The rate of growth of output can be expressed as the sum of the contributions of labor and capital inputs, and the rate of productivity growth.

The results are reported in table 1 for the postwar period 1948 to 1976, and for seven subperiods. Except for the 1973–76 period, the other subperiods are benchmarked with the years that represent peaks in the business cycle.

The table provides a summary of postwar economic activity. Looking at column 1, you can see that over the full period, output grew at an average annual rate of 3.5 percent per year. It reached its maximum at 4.83 percent during the period 1960 to 1966, and then increased at only 0.89 percent during the recession, and partial recovery of 1973 to 1976.

Among the source contributions, capital is the most important, with a postwar average contribution of 1.61 percent, followed by, in order of importance, productivity and labor growth. Capital input accounted for one-half of the productivity growth during that period.

What is striking is to compare column 1 with column 6. Economic growth plummeted to 0.89 percent from 3.5 percent. That is a full 2.61 percentage points below the postwar average.

During this period, the contribution of capital input fell to 1.26 percent for a drop of 0.35 percentage points from the postwar average. The rate of productivity growth, at a negative 0.70 percent dropped 1.84 percentage points below its 1948–76 average. This 1.84 percentage point decline accounts for 70 percent of the slowdown in economic growth in the United States.

Well, the implication is clear. A detailed explanation of the fall in the rate of productivity growth is needed to account for the slowdown in U.S. economic growth.

Now, as a first step in identifying the sources of the productivity slowdown, the rate of productivity growth is decomposed into components that represent the weighted sum of rates of productivity growth for individual sectors and the contributions to aggregate productivity growth of reallocations of output, capital input, and labor input. The notion of reallocations is easy to understand.

For example, if capital input moves from a sector, from which it has a low rate of return, to a sector where it has a higher productivity payoff, then the total amount of capital input in the economy has not changed, but productivity has increased. Capital has moved to a more productive use. Similarly, for labor.

What is the importance of that? Well, the importance of it is that the changes in the aggregate rate of growth can be due to one of two things; either by changes in the underlying sectoral rates of productivity growth, or due to shifts in economic activity among sectors. If it is the former, the decline in sectoral productivity growth, then economic policy should stimulate productivity growth for all industrial sectors.

If, however, the productivity decline is due to shifts in economic activity, then what has been called an industrial strategy might be more appropriate.

The results of the analysis are reported on the bottom of table 1. In the first column, overall, for the 1948 to 1976 period, you can see that sectoral productivity growth averaged 1.24 percent per year. But the combined effect of all reallocations were a negative 0.10 percent; though negative, they were small. They were trivial in comparison to the contributions of sectoral rates of productivity growth.

More importantly, compare that with the last column. The decline in sectoral productivity growth was negative, 1.13 percent. The combined effect of all reallocations were positive.

Now, what does that mean? If you look at the last column, and look at the fourth entry, that negative 0.7 percent, the aggregate rate of productivity growth is falling 0.7 percent. Sectoral rates are falling 1.3 percent. The only thing that prevented the sectoral decline from converting directly to a larger aggregate decline is that resources were being moved to more productive uses, and that makes sense, especially in a mild recessionary period. You get factors shifting, firms are exiting, capital is being reallocated, some laborers are finding employment in more productive jobs, resources are being reallocated. It makes sense that, especially in the post-

1966 period, you see the effect of resource allocations being positive. In fact, they have helped us tremendously.

Let me now change the breadth of my testimony, and look at individual microsectors, and here, you might want to focus on table 2.

As part of a larger study, measures of total factor productivity—and now we are at the sectoral level, we are looking at labor, capital, materials, and energy—were developed for each of 45 industrial sectors in the private business economy, and they are developed in table 2.

Here I divide the analysis at 1966. I think that is most informative, because 1966 is commonly accepted as the dividing point between the earlier high growth, high productivity growth, postwar era, and the beginning of the decline in U.S. productivity growth.

Now, if you stare at table 2, even to the casual eye, you see a pattern. Among the 45 sectors, 34 experienced declines in their annual rates of productivity growth between the pre-1966 and post-1966 subperiods. Only 10 sectors registered increases.

Moreover, not only did three-fourths of the sectors exhibit decreasing productivity growth rates, but the average annual decline endured by these 34 sectors was nearly twice as large as the average annual increase calculated for the 10 sectors enjoying increased rates of productivity performance. Those that experienced declines averaged 2 percent declines; those that experienced increases, on average, experienced a 1-percent increase.

The conclusion is that the productivity slowdown in 1966 was not only widespread, but substantial. I might add that the conclusion is robust, no matter how you approach the question. The median annual rate of sectoral productivity growth in the 1948 to 1966 period was 1.02 percent; in the 1966 to 1976 period, it was negative, −0.09 percent. The simple unweighted average of annual sectoral rates fell by nearly the same amount, from 1.05 percent in the pre-1966 period to −0.25 percent in the post-1966 period.

The statistical analysis that the mean and median declined by similar amounts, and from similar levels, is consistent with the conclusion that the productivity decline has occurred rather uniformly across the economy.

Now, the full extent of the importance of this decline in sectoral performance for the macro economy is determined by weighting each sector's growth rate by that sector's share in aggregate output. Between those two subperiods, the weighted average of annual sectoral productivity growth rates, declined from 1.97 percent to negative 0.07 percent.

In spite of this 2.04 percentage point decline, table 1 reveals that aggregate productivity growth slowed by 1.5 percentage points over the same period. The difference is that again resources were being reallocated to more productive uses. Had it not been for that resource allocation among sectors, the aggregate productivity decline would have been 30 percent higher.

Now, the seriousness of the sectoral productivity story is revealed by looking at table 3, by focusing on those sectors whose productivity growth rates reflect a large change between the two subperiods. From table 2, what I did is identify all sectors whose change was more than 2.5 percentage points, whether negative or positive.

If you look at the list on table 3, you will see that there are 10 sectors that meet that criterion, and all 10 experienced negatives. All were declines. So the large changes were all negative.

Finally, table 4 provides a useful summary. During the 1948 to 1966 subperiod. only eight sectors exhibited negative productivity growth rates, and only two had rates of decline more than 1 percent. In post-1966, the story changed dramatically.

Now, 24 of 45 sectors had negative growth rates, and 15 of these had productivity declining at rates exceeding minus 1 percent per year. The productivity decline has not been isolated to a few sectors. It has been widespread.

In summary, these sectoral results confirm the conclusions derived from the earlier discussion of aggregate productivity growth. The slowdown in aggregate productivity growth is not the result of a decline in sectoral productivity in only a few important sectors, nor is it the result of shifts in economic activity from high to low productivity growth sectors.

In contrast to those who maintain that sectoral shifts explain our productivity problems, market reallocations of outputs and inputs increased aggregate productivity growth by one-half a percentage point between the pre- and post-1966 period.

It is the importance of that question which I am currently investigating in the research sponsored by the Committee for Economic Development.

In conclusion, let me state that productivity research has two principal objectives: measurement and interpretation. The very definition of microeconomics suggests that a total factor productivity framework not only offers the most meaningful barometer of an economy's performance, but also provides a useful device for understanding and interpreting the linkages between micro sectors and the macro economy.

Our research indicates that the decline in sectoral productivity is neither mythical nor an isolated event. There is no evidence supporting the sectoral shift hypothesis adhered to by some industrial strategists.

Reasonable people may disagree about the relative merits of solutions. I can only offer that the evidence that I have seen clearly suggests that to reverse the downward trend in the productivity performance of the aggregate economy, policies must be designed to stimulate sectoral productivity growth across the economy.

Thank you.

[The prepared statement of Mr. Gollop follows:]

Testimony
of
Professor Frank M. Gollop
Boston College

Mr. Chairman and Members of the Subcommittee:

I am pleased to have this opportunity to discuss with you problems of productivity measurement and declining productivity in the United States.

Productivity is perhaps one of the best single measures of economic performance. It concerns how well an economy or an individual business transforms inputs into outputs.

In recent years, the process of productivity growth has slowed to disappointingly low levels. More important, it has become clear that improved productivity must be a key element in any long run solution to inflation, unemployment, and the declining international competitiveness of U.S. business.

My testimony has two purposes. First, I will introduce some fundamental issues in productivity measurement. I hope to convince you that economic principles suggest that a total factor productivity framework offers the most meaningful measure of productivity growth. Second, I will present and discuss results of economic research applying total factor productivity to the study of aggregate and sectoral productivity growth in the postwar United States. The important conclusion is that the productivity slowdown is not limited to a few important isolated sectors. Correctly measured, the decline in productivity growth is pervasive.

1. Issues in Productivity Measurement

Output per hour worked, or labor productivity, is the traditional productivity measure. During the 1950's, the increasing capital intensity of U.S. business forced economists to restructure their measure of productivity growth so as to incorporate both labor and capital inputs. A multi-factor measure emerged. The events of the past decade urged a further restructuring. Energy and material inputs no longer could be ignored. Emphasis shifted from measuring productivity growth for the aggregate economy to evaluating productivity performance at the level of microeconomic sectors. A measure of total factor productivity evolved.

Labor, multi-factor, and total factor productivity models offer fundamentally different descriptions of productivity growth. At the sectoral level, for example, the growth in labor productivity is defined as the growth in output unexplained by the growth in labor input. In polar contrast, the growth in total factor productivity is defined as the growth in output unexplained by the growth in labor, capital, material, and energy inputs. The important question is: Which model forms a more appropriate basis for measuring productivity growth?

The answer, I believe, follows directly from economic principles. Productivity growth, recall, is a measure of economic performance. The role of any economic performance measure is to serve as a barometer, sensitive to the economy's success in solving its economic problem: the allocation of scarce resources to satisfy human wants. What makes this problem an economic one is scarcity, a concept no more appropriate to labor than to capital, energy, or material inputs. In short, the efficient solution to society's economic problem involves all inputs. The implication is clear. A well-defined index of productivity growth must measure how well the economy allocates and uses its scarce resources, all its scarce resources.

This principle has important implications for measuring productivity growth at both aggregate and sectoral levels. Primary inputs for the macro economy include labor and capital inputs. Intermediate goods are excluded. Sectoral deliveries to intermediate demand (steel produced for the automobile industry) and intermediate input purchases (steel consumed by the automobile industry) are self-canceling transactions within the macro economy. In contrast, studies of firm or sectoral productivity must include all labor, capital, and material inputs including energy. Steel is as primary to the automobile industry as is labor or capital. At the sectoral level, transactions in material inputs are not self-canceling. Moreover, they are not unimportant. In manufacturing, material inputs typically account for as much as sixty-five percent of input costs. Given market prices, a firm chooses a particular combination of capital, labor, material, and energy inputs. As prices change, the firm rationally adjusts its total input mix. As a performance measure, productivity growth must treat all inputs symmetrically.

The importance of including material goods and services in a productivity study is easily demonstrated. A supermarket manager can choose to have his own employee display frozen ice cream products in the frozen foods cabinet or he can contract with the "raw materials" supplier to have its delivery person display the product. The former is a direct labor cost to the supermarket; the latter is an expense related to material input. Presumably, the store manager makes this choice on the basis of the relative productivities and prices of his own employee and the delivery person. Assume the manager first uses the delivery person. Later, if the productivity of his own employees increases, it may be possible to produce the same output for less cost by substituting his own laborer for the material input of the delivery person. Costs will be lowered; productivity enhanced. Measured total factor productivity will increase, but measured labor productivity will decline. Excluding material inputs from the measure of productivity growth not only presents a distorted characterization of the manager's rational behavior but also may bias any subsequent analysis of the trend and sources of the industry's productivity growth.

Perhaps the most persuasive argument for a total factor productivity approach to productivity research lies in the economy's experience during the past decade. Excluding intermediate input from a model of productivity growth is equivalent to ignoring the productivity consequences of the decade's oil embargo, rapidly rising energy prices, the later coal strike, and the consequent bottlenecks in interindustry transactions. Recent events have impressed us with the importance of the microeconomic foundations of aggregate productivity growth. The economy does not consist of horizontally independent sectors. It is, instead, a set of vertically interdependent sectors, each dependent on both intersectoral and international transactions. Only the total factor productivity model recognizes these transactions. Only it describes how an individual sector transmits the benefits of its productivity growth to final consumers both directly through deliveries to final demand and indirectly through deliveries to intermediate demand. Long term economic trends can be understood and projected only by relating economy-wide developments to changes in economic activity at the level of industrial sectors.

If productivity measures are to serve as meaningful barometers of society's success in solving its economic problem, then neither material inputs nor intersectoral linkages can be ignored. Measures of productivity growth must treat all inputs--labor, capital, energy, and materials--symmetrically.

The total factor productivity model has been applied to the study of both aggregate and sectoral productivity in the postwar United States. I now would like to present a summary of the findings of that research, a project designed by Dale Jorgenson, Barbara Fraumeni, and myself.[1]

2. The Story of Postwar Economic Growth

The United States economy experienced rapid economic growth over the early postwar period. Recent performance, however, has been less impressive. The rate of economic growth peaked during the period 1960 to 1966. Growth rates slowed substantially between 1966 and 1973 and have declined to disappointingly low levels since 1973. Concurrent with the decline in economic growth has been the precipitous deterioration of productivity growth.

Analysis of the slowdown begins with the decomposition of the growth of output during the postwar period into its source components. The rate of growth of output can be expressed as the sum of the contributions of labor and capital inputs and the rate of productivity growth.[2] The contribution of each input is the product of the input growth rate and the average share of the input in the value of output. The results are reported in Table 1 for the postwar period 1948-1976 and for seven subperiods. Except for the 1973-1976 period, each subperiod covers economic activity from one cyclical peak to the next. The last subperiod ends in 1976, a year of recovery from the sharp downturn in economic activity in 1974 and 1975.

The table provides a summary of postwar economic activity. Over the full postwar period, output grew at an average annual rate of 3.5 percent. It reached its maximum at 4.83 percent during the period 1960-1966 but increased at only .89 percent during the recession and partial recovery of 1973-1976. Among the source contributions, capital is the most important with a postwar average contribution of 1.61 percent. Accounting for nearly half of the postwar growth in output, capital is followed in importance by productivity growth and labor input with average annual contributions equal to 1.14 percent and .75 percent, respectively.

The summary description of economic activity during the 1973-1976 period is striking. Economic growth at 0.89 percent per year was a full 2.61 percentage points below the postwar average of 3.5 percent. During this period, the contribution of capital input fell to 1.26 percent for a drop of 0.35 percentage points from the postwar average. The contribution of labor input fell to 0.33 percent, a 0.42 percentage point drop from its postwar average. The rate of productivity growth at a negative 0.70 percent dropped 1.84 percentage points below its 1948-1976 average. This 1.84 percentage point decline accounts for 70 percent of the 2.61 percentage

Table 1

GROWTH OF OUTPUT AND SOURCE CONTRIBUTIONS FOR THE U.S. ECONOMY, 1948-1976

	1948-1976	1948-1953	1953-1957	1957-1960	1960-1966	1966-1969	1969-1973	1973-1976
Output	0.0350	0.0457	0.0313	0.0279	0.0483	0.0324	0.0324	0.0089
Contributions to Economic Growth								
Capital Input	0.0161	0.0194	0.0154	0.0109	0.0156	0.0211	0.0161	0.0126
Labor Input	0.0075	0.0097	0.0013	0.0057	0.0116	0.0108	0.0068	0.0033
Productivity Growth	0.0114	0.0166	0.0146	0.0113	0.0211	0.0004	0.0095	-0.0070
Contributions to Productivity Growth								
Sectoral Rates of Productivity Growth	0.0124	0.0219	0.0177	0.0145	0.0217	0.0025	0.0048	-0.0113
Combined Effects of Reallocations	-0.0010	-0.0053	-0.0030	-0.0032	-0.0006	-0.0020	0.0046	0.0043

Source: Fraumeni and Jorgenson (1980).

point drop in economic activity. The implication is clear. A detailed explanation of the fall in the rate of productivity growth is needed to account for the slowdown in U.S. economic growth.

As a first step in identifying the sources of the productivity slowdown, the rate of productivity growth is decomposed into components that represent the weighted sum of rates of productivity growth for individual sectors and the contributions to aggregate productivity growth of reallocations of output, capital input, and labor input.[3] Changes in the aggregate rate of productivity growth can be caused by changes in the underlying sectoral rates of productivity growth and/or by reallocations or "shifts" in economic activity among sectors. If the former is the source of the productivity slowdown, then economic policy should stimulate productivity growth for all industrial sectors. If the latter is responsible, then economic policy should be focused on the reallocation of output among sectors, the apparent objective of industrial revitalization programs.

The results of our analysis are reported at the bottom of Table 1. For the 1948-1976 period, productivity growth at the aggregate level is dominated by the contribution of sectoral productivity growth of 1.24 percent per year. The combined effect of all reallocations is a negative 0.10 percent, but is negligible relative to the effect of sectoral productivity growth. For the subperiod of interest, 1973-1976, the reallocation of outputs and inputs among sectors made positive rather than negative contributions to aggregate productivity performance. The combined contribution of all reallocations rose to 0.43 percent for a gain of 0.53 percentage points from the postwar average. Economic policies directed at revitalizing the economy by reallocating economic activity among sectors appear unwarranted. In contrast, economic policy should focus on stimulating productivity growth across all industries. During 1973-1976, the contribution of sectoral technical change fell to a negative 1.13 percent per year for a drop of 2.37 percentage points from its postwar average. It follows that the declines in rates of sectoral productivity growth must bear full responsibility for the slowdown in the economy-wide rate of productivity growth.

To summarize the analysis of the sources of the 1973-1976 productivity slowdown, the 2.61 percentage point drop in economic growth from its postwar average is the sum of 0.35 and 0.42 percentage point declines in the respective contributions of capital and labor inputs, a sharp 2.37 percentage point decline in the contribution of sectoral productivity growth, and a 0.53 percentage point rise in the effect of output and input shifts among sectors. Whatever the causes of the slowdown, they are to be found in the deterioration of productivity growth at the sectoral level.

3. Sectoral Productivity Growth

As part of a larger study, measures of total factor productivity were developed for each of 45 industrial sectors in the private business economy. The results of that research are summarized in Table 2 for the full postwar period and for two subperiods, 1948-1966 and 1966-1976. The full period is divided at

Table 2
Productivity Growth by Sector, 1948-1976

	Average Annual Rates		
	1948-1976	1948-1966	1966-1976
Agricultural Production	.0216	.0240	.0169
Agricultural Services	-.0115	-.0013	-.0311
Metal Mining	.0029	.0059	-.0025
Coal Mining	-.0046	.0160	-.0439
Crude Petroleum & Natural Gas	-.0057	.0117	-.0389
Nonmetallic Mining	.0012	-.0066	.0159
Contract Construction	.0007	.0098	-.0166
Food and Kindred Products	.0129	.0208	-.0020
Tobacco	-.0044	.0028	-.0181
Textiles	.0138	.0191	.0038
Apparel	.0090	.0071	.0127
Paper	-.0038	-.0046	-.0023
Printing and Publishing	.0082	.0060	.0125
Chemicals	.0187	.0233	.0100
Petroleum and Coal Products	-.0015	.0177	-.0381
Rubber and Plastics	.0054	.0054	.0054
Leather	.0067	.0079	.0043
Lumber and Wood Products (ex. Furniture)	-.0087	.0015	-.0283
Furniture and Fixtures	.0104	.0136	.0045
Stone, Clay and Glass	-.0008	.0013	-.0049
Primary Metals	-.0068	-.0042	-.0116
Fabricated Metals	.0032	.0081	-.0061
Machinery (ex. Electrical)	.0034	.0065	-.0024
Electrical Machinery	.0118	.0129	.0098
Transportation Equipment and Ordnance (ex. Motor Vehicles)	.0070	.0107	-.0001
Motor Vehicles	.0124	.0132	.0109
Instruments	.0060	.0106	-.0027
Misc. Manufacturing	.0115	.0098	.0149
Railroads and Rail Express	.0178	.0232	.0076
Street Rail, Bus Lines and Taxis	-.0135	-.0113	-.0176
Trucking and Warehousing	.0150	.0194	.0065
Water Transportation	.0081	.0002	.0232
Air Transportation	.0162	.0377	-.0245
Pipelines (ex. Natural Gas)	.0506	.0565	.0393
Transportation Services	-.0263	-.0312	-.0171
Telephone and Telegraph	.0229	.0264	.0164
Radio and TV Broadcasting	-.0099	-.0087	-.0122
Electric Utilities	.0204	.0408	-.0184
Gas Utilities	.0103	.0219	-.0117
Water Supply and Sanitation Services	.0084	.0191	-.0118
Wholesale Trade	.0107	.0113	.0095
Retail Trade	.0098	.0158	-.0016
Finance, Insurance, and Real Estate	-.0002	-.0041	.0073
Services (ex. Private Households and Institutions)	.0067	.0043	.0113
Non-Profit Institutions	.0044	.0022	.0086
Weighted Average	.0124	.0197	-.0007
Unweighted Average	.0060	.0105	-.0025

Source: Fraumeni and Jorgenson (1980).

1966 since that year is commonly accepted as marking both the end of the golden age of postwar economic growth and the beginning of the decline in U.S. productivity growth.

Though Table 2 makes clear that rates of productivity growth vary considerably across sectors, it reveals, more importantly, that a similar pattern describes the postwar productivity performance of most sectors. Among the 45 sectors, 34 experienced declines in their annual rates of productivity growth between the pre-1966 and post-1966 subperiods. Only 10 sectors registered increases. (One sector's rate was unchanged.) Moreover, not only did three-fourths of the sectors exhibit decreasing productivity growth rates, but the average annual decline endured by these 34 sectors (-2.02 percentage points) was twice the average annual increase calculated for the 10 sectors enjoying increased rates of productivity performance (1.04 percentage points). The productivity slowdown beginning in 1966 has been widespread and substantial.

This conclusion is robust no matter how one evaluates the data reported in Table 2. The median annual rate of sectoral productivity growth in the 1948-1966 period was 1.02 percent; in the 1966-1976 period, it turned negative at -0.09 percent. The simple unweighted average of annual sectoral rates fell by nearly the same amount, from 1.05 percent in the pre-1966 period to -0.25 percent in the post-1966 period. That the mean and median both declined by similar amounts is consistent with the conclusion that the productivity decline has occurred rather uniformly across the economy.

The full extent of the importance of this decline in sectoral performance for the macro economy is determined by weighting each sector's growth rate by that sector's share in aggregate output. Between the two subperiods, the weighted average of annual sectoral productivity growth rates decreased by more than two full percentage points, from 1.97 percent to -0.07 percent. In spite of this 2.04 percentage point decline, Table 1 reveals that aggregate productivity growth slowed by 1.5 percentage points over the same period. What prevented the sectoral decline from resulting in an equivalent decline in aggregate performance was a positive 0.54 percentage point contribution resulting from the market-directed reallocation of inputs and outputs to higher productivity growth rate sectors. Had it not been for these sectoral shifts, the decline in macro performance would have been larger by 30 percent.

The seriousness of the sectoral productivity story is revealed further by focusing on those sectors whose productivity growth rates exhibit a "large" change between the two subperiods. Defining a large change as any change exceeding 2.5 percentage points (whether negative or positive), Table 3 identifies 10 sectors that meet this criterion. In all cases, the large changes are negative.

Table 4 provides a useful summary. During the 1948-1966 subperiod, only eight sectors exhibited negative productivity growth rates. Only two sectors (transportation services and street rail, bus lines, and taxicabs) had annual rates less than minus one percent. In sharp contrast, 24 of 45 sectors had negative growth rates during the later 1966-1976 period and 15 of these had productivity declining at rates exceeding minus one percent per year. The productivity slowdown has not been limited to a few isolated sectors. It has been pervasive.

Table 3

Sectors Exhibiting Large Changes in Total Factor Productivity Growth[a]

Sector	Percentage Point Change
Agriculture Services	-2.98
Coal Mining	-5.99
Crude Petroleum and Natural Gas	-5.06
Construction	-2.64
Petroleum and Coal Products	-5.58
Lumber and Wood Products (ex. Furniture)	-2.98
Air Transportation	-6.22
Electric Utilities	-5.92
Gas Utilities	-3.36
Water and Sanitation Services	-3.09

Source: Table 2.

[a] A large change between 1948-1966 and 1966-1976 is defined as any change, positive or negative, exceeding 2.5 percentage points.

Table 4

Distribution of Sectoral Productivity Growth Rates

Average Annual Rates of Growth	1948-1966	1966-1976
Less than -4%	0	1
-4% to -3%	1	3
-3% to -2%	0	2
-2% to -1%	1	9
-1% to 0	6	9
0 to 1%	15	11
1% to 2%	13	8
2% to 3%	6	1
3% to 4%	1	1
more than 4%	2	0

Source: Table 2.

Finally, it is informative to compare weighted and unweighted average rates of productivity growth within and between subperiods. The weighted average of sectoral growth rates for the 1948-1966 subperiod is 1.97 percent. It exceeds the period's unweighted average of 1.05 percent, implying that, in general, sectors having large shares in national output have higher rates of productivity growth than sectors having small shares. The same holds true for the 1966-1976 subperiod. The weighted average -0.07 percent exceeds the unweighted average -0.25 percent. However, note that the weighted average has declined more between the two subperiods (-2.04 percentage points) than has the unweighted average (-1.30 percentage points). This suggests that while industries with large output shares have continued to have higher rates of productivity growth than smaller sectors, the large sectors have suffered greater declines in their own rates of productivity growth.

In summary, these sectoral results confirm the conclusions derived from the earlier discussion of aggregate productivity growth. The aggregate rate has declined because of widespread and substantial declines in sectoral productivity growth. The slowdown in aggregate productivity growth is not the result of a decline in sectoral productivity in only a few important sectors, nor it is the result of shifts in economic activity from high to low productivity growth sectors. As Table 1 indicates, the average annual contribution of output and input reallocations was -0.29 percent during the 1948-1966 subperiod and 0.25 percent during 1966-1976. In contrast to those who maintain that sectoral shifts explain our productivity problems, market reallocations of outputs and inputs increased aggregate productivity growth by 0.54

percentage points (-0.29-0.25) between 1948-1966 and 1966-1976.

4. Conclusion

Productivity research has two principal objectives: measurement and interpretation. Basic economic principles suggest that a total factor productivity framework not only offers the most meaningful barometer of an economy's performance but also provides a useful device for understanding and interpreting the linkages between micro sectors and the macro economy. Our research indicates that the decline in sectoral productivity is neither mythical nor an isolated event. There is no evidence supporting the sectoral shift hypothesis adhered to by some industrial strategists. Policies designed to stimulate sectoral productivity growth across the economy can reverse the downward trend in the productivity performance of the aggregate economy and thereby restore moderate economic growth.

Notes

1. The basis for my testimony is a long-term research project studying aggregate and sectoral productivity growth, a project I personally have been involved in for ten years. The project is chaired by Professor Dale Jorgenson of Harvard. Early results are reported in Gollop and Jorgenson (1980). Results for the 1948-1976 period, the basis for my present testimony, are reported in Fraumeni and Jorgenson (1980, 1981). We are in the process of updating our analysis through 1979.

2. The methodology underlying this decomposition is described by Jorgenson (1980).

3. For a detailed discussion of the methodology underlying this decomposition , see Jorgenson (1980).

References

Fraumeni, Barbara M., and Dale W. Jorgenson (1980), "The Role of Capital in U.S. Economic Growth, 1948-1976," in George M. von Furstenberg, ed., Capital, Efficiency, and Growth, Cambridge, Ballinger, pp. 9-250.

________________ (1981), "Substitution and Technical Change in Production," in Ernst R. Berndt and Barry Field, eds., The Economics of Substitution in Production, Cambridge, M.I.T. Press, forthcoming.

Gollop, Frank M., and Dale W. Jorgenson (1980), "U.S. Productivity Growth by Industry: 1947-1973," in J.W. Kendrick and B. Vaccara, eds., New Developments in Productivity Measurement and Analysis, Studies in Income and Wealth, Vol. 4, Chicago, University of Chicago Press, pp. 17-136.

Jorgenson, Dale W. (1980), "Accounting for Capital," in George M. von Furstenberg, ed., Capital, Efficiency and Growth, Cambridge, Ballinger, pp. 251-319.

Senator QUAYLE. Thank you very much.

If you will turn back to this first table, I notice in the comparison on the productivity growth to the sectoral rate of productivity growth, that in every case except for one, that the sectoral rate of productivity growth was higher, and that is, the exception was in 1969 to 1973, where you have got .0095 for productivity growth, but then a decline for the sectoral rate of productivity growth.

What is the aberration in that timeframe, do you know?

Mr. GOLLOP. You are talking about the 1969 to 1973 period?

Senator QUAYLE. Yes, on the 1969 to 1973, I am looking over across the board, you are comparing the productivity growth to the sectoral rate of productivity growth.

Mr. GOLLOP. Right.

Senator QUAYLE. The sectoral rates of productivity growth are greater, or more productive, except this one period of 1969 to 1973.

Mr. GOLLOP. Actually, it is the last two columns, Senator. In the last column, as well, it is a negative 1.3 percent.

Senator QUAYLE. That is right, it is a negative.

Mr. GOLLOP. The importance of that question is to focus on the very last row of this table. The last two entries, in the last two periods, you see the combined effect of reallocations.

What this is suggesting, in 1969 onward, through 1976, which is as far as this research has gone, that it is during that period that inputs have been shifting to sectors where they have more productive users.

The point is that the combined effect of those reallocations have helped productivity growth. Average productivity growth across sectors, for example, in the 1969 to 1973 period was about one-half a percent, 0.48 percent. Had it not been—had it not been for input and output shifting among sectors, if that last entry in that last row had been zero, then that 0.48 percent sectoral productivity growth would have become 0.48 for the aggregate economy.

So, in fact, during that 1969 to 1973 period, about one-half of the productivity growth for the economy was coming from sectors, and about one-half was coming from input being reallocated among sectors.

Senator QUAYLE. Why is this happening right at 1966 to 1969? Is this a policy decision? What took place in that particular area?

You focus on 1966, and this data shows that 1969 there seems to be this change. Is there any reason?

Mr. GOLLOP. Well, as Dr. Rees has pointed out, reasonable men will differ on interpretations, and I suspect you should ask that question of everyone.

My own view is that starting around 1969, and then fundamentally after 1973, I am of the school that energy prices really did us in. The story goes like this. Technologies that are operational in the early seventies were put on line in the forties, fifties, and sixties. Consider electric power. Some of the coal generators had been around for 30 years, and engineers designed those in the forties and fifties and sixties, because they saw that, relative to other prices, fuel prices were going down. So the right thing for them to do was to build technologies, which economists would call fuel-using. It is rational.

Use the inputs that are cheap. Now, whether that is a result of policy or not, we both have our feelings. In any event, 1969 prices of fuels began to rise. Come 1973, they skyrocketed. Engineers did not make a mistake, they built the technologies correctly.

If we had a new technology on line in 1973—and I guess I could critique policymakers for not having an energy policy sooner, but hindsight is easy—if the engineers could have torn down the plants the next day, they would have built electric utilities plants that were energy saving.

The statistical analysis that I have been involved in, in 29 of 35 sectors, the technologies are in fact energy using. In table 3 reporting the large negative changes, eight of those changes occur in energy using sectors. If a sector is energy using, when the price of energy goes up, the technology says that productivity growth is going to come from more intense energy. At the same time, the market is struggling and telling you to get out of that input—but you are bound until you can replace it, and that is going to take time.

Senator QUAYLE. Do you feel that the energy policy and the energy factor is a key ingredient for why we have these declining rates of productivity, and if so, do you see a leveling off, and as new technologies come in, that would be far more conscientious and sensitive to energy concerns, that in fact because of that technological change that the productivity rates will begin to climb back up?

Mr. GOLLOP. Yes, that is a logical conclusion, from my view, with this understanding.

I do not want to be interpreted as saying that we should lower energy prices. If anything, they might have to go higher. I would not want to see that. That is why I am totally in favor of trying to increase capital investments through lower tax rates, because it turns out that that is one way to stimulate productivity growth, because the evidence shows that while the technology in place is energy and fuel using, and therefore hurt by raising energy prices, it also shows that they are capital using.

If we can lower the price of capital, that in tandem with introducing new innovations that are energy saving, should help us out a lot.

Senator QUAYLE. Let me ask both you and Mr. Rees this question.

Do you think that it would be helpful, from a point of view of interpretation, and focus of national attention, on a so-called national productivity factor, such as we have in CPI, wholesale and retail, CPI's, that it would be beneficial to us to develop a productivity factor that we could view—I do not know if it would be possible to do it from month to month, but certainly year to year, every 6 months, do you think this would be advisable?

I believe, Mr. Rees, in closing you mentioned something along those lines. I just wonder if we could expand on it, and try to pinpoint if this would be a proper course to pursue.

Mr. REES. We do have a broad national measure for the private business sector that is issued quarterly. It is not as well known by the general public as the CPI or the PPI.

Senator QUAYLE. Who issues that?

Mr. REES. The Bureau of Labor Statistics issues it.

Senator OUAYLE. It is just for the private sector?

Mr. REES. Yes, because you do not have an independent measure of output for the Government sector, as a whole. There are some series on productivity in particular Government functions, but most Government output is hard to measure.

Senator QUAYLE. What about a total productivity factor?

Mr. REES. The measure that is available now is a labor productivity measure, and what I advocated in my statement was broadening that, to make it a total factor productivity measure, in the sense in which I am using it, that is labor plus—capital combined. At that level of aggregation, I do not think you want to put in materials and energy.

I quite agree with Dr. Gollop, that for particular industries, a measure which includes energy and materials inputs is very useful.

Senator, I wonder if I could comment on the question that you asked Dr. Gollop, about the causes of productivity slowdown?

As usual, when you have two economists, you have two opinions. I am afraid I do not fully agree with his answer to you.

I have two difficulties with the answer. One is, that the productivity slowdown began too soon to be sensibly explained by the rise in energy prices. It began in 1973. The productivity slowdown began in 1967.

The other difficulty with that explanation that I have is that some other economies that have not experienced productivity slowdown, such as the Japanese economy, were impacted even more seriously by the rise in energy prices than the American economy was.

So while I do not deny that it may be a factor, I would not give it the very heavy importance that Dr. Gollop did.

Senator QUAYLE. Would you agree that 1966 to 1969 is where productivity began to fall?

Mr. REES. Yes, the midsixties is the breaking point, and I think what began to happen in the midsixties is that we got a very sharp increase in the rate of inflation, and that the interaction between the rate of inflation and the kinds of tax system that we had in place discouraged investment in productive capital.

I do not think that the total level of savings is the culprit, so much as their use. When you have inflation, and when you have the kinds of tax system that we had at that point—fortunately it has been modified in important respects more recently. You create a big incentive for people to put their savings into nonproductive forms of investments, into gold, into works of art, into land, into residential real estate, and so we were not getting the—rate of investment in productive facilities that we needed to maintain our productivity growth.

Mr. GOLLOP. Could I just comment?

Actually, Dr. Rees and I do not disagree that much.

Energy prices actually started increasing, although not like that for 1973, in 1969. I think they explained most of what has gone on.

I fully agree with Dr. Rees, about 1966-67 being the breaking point, and with the importance of inflation. Just the simple fact of what inflation does to capital recovery, to depreciation loss, is enough. But what drove us from a positive growth after 1973, in large part, cannot be solely explained by inflation. It is not that simple, but it is, in large part, by energy prices. That is why I am an advocate, last year and this year, in terms of reducing the price of capital through tax reform.

Senator QUAYLE. Do you feel that the energy price escalation was a major factor in the rise in inflation?

Mr. GOLLOP. That certainly was an important part of it, because energy is so basic to the economy. It is at the bottom of the pyramid. It is fed into so many sectors.

Look at what happened to electric power. If you look at the pre-1966 period, it was always, no matter who did it, Kendrick, Coletaker, whoever put out the measures, it was one of the top three periods of growth. Post-1973, it is the bottom of the pack.

Senator QUAYLE. Let me see if I can get a further agreement between the two of you.

Do you both agree that there should be some national total productivity factor?

Mr. GOLLOP. Yes, and I agree with Dr. Rees that at the aggregate level, the primary inputs to the economy are labor and capital.

Senator QUAYLE. So you are saying not just labor?

Mr. GOLLOP. No, it has got to be labor and capital.

Senator QUAYLE. Now, do you think if we agree on that, do you think we can get an agreement on what will go into it, as far as the capital input? If we are going to have this national figure, we are going to have to agree to what is going to go in there, and I think I detect a little bit of disagreement there.

I wonder if there is a way that the Congress, or the Department of Labor, will be able to get some kind of consensus on this, so we could have a figure that we would use, and we would—everyone would be able to interpret it in a way reasonably similar.

Mr. REES. Well, measuring capital services is a difficult technical job, and I would not want to advocate one particular measure. I would yield to Dr. Gollop and to Mr. Norsworthy, as to just what ought to go in that measure.

It is possible to produce a measure. Private economies do produce it, and use it, and there is no reason why it should not be part of the official Government statistics. If you have a measure of total factor productivity, and a measure of labor productivity side by side, it is possible to look immediately at what the effect is of the increasing or decreasing capital intensity of the economy, and to eliminate that as one cause of the movement in your labor productivity.

So you come back closer to understanding why your labor productivity measure is going up or down.

Mr. **Gollop**. I totally agree. The discussion of what should be in the measures of capital inputs has been going on in the academic literature since World War II; but I would bet that even if you got economists at this table, of every different stripe, they would agree to what fundamentally should be in that measure, and they would be citing much the same data.

But no matter what their differences are, that total factor measure of productivity at the aggregate level is going to be a more useful source advice than the best existing measure output per man hour.

Senator **Quayle**. That is what you are saying now, that we should work to improve it. OK.

Well, I thank both of you gentlemen, Dr. Rees and Dr. Gollop.

Our next panel, from Princeton and New York Universities, is Mr. Baumol; from the Department of Labor, Mr. Norsworthy.

OK, Dr. Baumol, do you want to proceed?

STATEMENTS OF WILLIAM J. BAUMOL, PROFESSOR OF ECONOMICS, PRINCETON AND NEW YORK UNIVERSITIES, AND PROJECT DIRECTOR, FORTHCOMING POLICY STATEMENT ON "PRODUCTIVITY POLICY: KEY TO THE NATION'S FUTURE" FOR COMMITTEE FOR ECONOMIC DEVELOPMENT; AND J. R. NORSWORTHY, CHIEF, DIVISION OF PRODUCTIVITY RESEARCH, OFFICE OF PRODUCTIVITY AND TECHNOLOGY, BUREAU OF LABOR STATISTICS, U.S. DEPARTMENT OF LABOR

Mr. **Baumol**. Thank you very much.

I would like to introduce myself. My name is William J. Baumol. I am professor of economics at Princeton University and New York University, past president of the American Economic Association, and I am now working on a statement on "Productivity Policy" for the Committee for Economic Development.

It is certainly a great honor and privilege to be invited to appear here today, particularly on so important a subject for the future of our country. I hope today's hearing can constitute a step toward removing a dark shadow which hangs over our economy.

I intend today to discuss four topics, and in discussing these orally, I will depart materially from the written statement.

Senator **Quayle**. Your full text will be incorporated in the record.

Mr. **Baumol**. Thank you very much.

I hope today to discuss four topics. First, a few comments on the seriousness of the problem; second, in accord with the subject of today, a few words on issues measurement; third, the consequences for our international competitiveness, and finally, some remarks on remedial measures commonly proposed.

I hope to offer a few observations on each topic which perhaps go beyond the standard views. On the nature of the problem, most statisticians, and many observers, have focused on the 15-year decline in our rate of productivity growth, and this really is a problem. I will not repeat the sort of statistics which you have just seen. Those are well enough known for our purposes.

Yet, from the viewpoint of our international position, the problem is a longer, more serious, and somewhat different one. It is not affected primarily by the decline in our productivity, but by the comparison of our productivity growth rate with that of other countries, and the fact that our inferior position in that respect extends even beyond the beginnings, or at least the officially accepted beginnings of our productivity decline.

We can compare ourselves with a number of countries and readily see the differences. For example, I will divide these figures into two periods, the 1960-73 period, in which productivity decline was fairly modest, and then 1973-79, in which it accelerated, and we will see that there has been a similar decline in other countries, but that even so, we were behind them before, and we remain behind them afterward.

In France, in the first of these periods, the productivity growth figures I have run about 6 percent a year in the earlier period, and in the latter period, about 4 percent; in Japan, about 9.9 percent in the earlier period, and 3.6 thereafter; the United Kingdom 3.8 and 2 while in the United States the figures were 3.1 and 1.4, meaning that in both periods growth was even lower than that of the United Kingdom that West Germany's growth in the earlier period was about twice as high as ours, 5.8 percent, and in the latter period, much more than twice as fast as ours, 4.2 percent a year.

So that we note that growth fell elsewhere, too, but the United States was behind, not only before, but also afterward. Behind not only Japan and West Germany, but also behind France and even the United Kingdom.

The French and German growth was twice as fast as ours, and the Japanese three times as big. If we take investment in manufacturing as a percent of GNP, we find that Japan's figure was about 26 percent, Britain's was about 14 percent, West Germany's about 14 percent, Canada's about 15 percent, and ours, less than 10 percent.

Again, the United States was well behind others. In many cases they were at least 50 percent ahead of us. Such discrepancies, if continued, for 10 or 20 years, mean that the United States must eventually fall far behind. The analog with the history of the United Kingdom, between 1870 and 1940, I find absolutely frightening. Let me turn now to my second subject, productivity measurements. There has been a great deal of debate, even surprisingly, emotion, devoted to this subject. Many measures and formulas have been proposed. You have heard today about the two prime indices, labor productivity, which is the output value divided by the quantity of labor input, and total factor productivity, which in effect is the value of output divided by the value of input. The first is perhaps the best indicator of the progress in living standards, that is, in output per consumer, but it is misleading in terms of the source of productivity gains because it ignores the role of capital and other inputs, and above all, the role of R. & D.

But, as we know, there are many variants of these two measures. In evaluating these, it is essential to recognize that there cannot be any one correct measure. The reason is, that there can be no single number, that is, no single productivity index which encompasses changes in thousands of inputs, hundreds of industries, and millions of different outputs.

Any one such number is at best a device that stirs the imagination, and is roughly indicative, but it must only describe average behavior, not behavior in all this large set of numbers. It cannot describe the rapidity of growth in telecommunications, the slow growth in the arts, the mixed records in various other manufacturing sectors. No one number can do that. Thus, the search for a single correct index is a search for a chimera, it is a snare and a delusion. But fortunately, that is not a debilitating handicap. For happily, most indices have been in agreement on the broad qualitative movements in productivity.

All agree that there has been a deceleration, all agree on the approximate date, all agree on the relative position of the United States and other countries. So that there is really no basic reason for unhappiness about the inherent ambiguity in the ideal definition of such an index, because in fact, as I have indicated, there can be no such ideal index.

I conclude from all this that we should really deemphasize the debate on how to measure the productivity growth decline. We should adopt the methods most commonly in use, and then get down to the serious tasks of studying the effects, the sources and the remedies relating to the productivity slowdown.

Let me, accordingly, return now to the third of my topics, one which is more substantive, in my view, the effect of the productivity slowdown on the competitive position of the United States on world markets.

The pain of the U.S. position on the world market, that is of the consequences of the productivity slowdown upon that position has already been felt in a number of areas. We know of its role in automobiles and steel, television receivers, computers, and a variety of other areas.

It may seem, at first, that if this threat continues, the United States will gradually be threatened with being driven, one by one, from the markets for each of its products. Along with this looming specter of exclusion from the world market, there is an accompanying specter of mounting and unprecedented unemployment levels in the United States.

But I should like to say that—that is not how things work out, at least in the long run. Economic analysis tells us that in one way the news is in fact better than this, but in another way, the news is far worse. The fact is that no country is ever driven from all of the markets of the world. Rather as its productivity lags, the exchange rates between that country's currencies and currencies of other countries, and the relative prices of its products, and theirs, will vary.

The prices of U.S. products, and its exchange rate will be driven downward over time, if our productivity continues to lag. This happens in the scenario because, as the goods become harder to sell, foreigners will be unwilling to buy them—as a result of the costs imposed by our declining productivity. There will therefore be a growing deficit in our balance of payments, and that will cause a revision in our exchange rates. As a result, foreign goods will in turn become sufficiently more expensive, to discourage Americans from buying them. That is, as our exchange rate falls, that will make foreign goods more expensive, and American goods will be decreasing in price, and that in turn will help us to sell them to foreigners.

In that way, ultimately, our balance of payments will be equilibrated, and the U.S. labor force will thereby continue to find jobs, much as it always has, both in the early period when our productivity was relatively low, and in more recent periods, going up to the early postwar period, when our productivity was very high. Even the United Kingdom labor force experienced high levels of employment through most of its period of lagging productivity growth.

But lest this picture, with the notion that we can retain our place in foreign markets, that we can balance our foreign exchange, that we can find jobs, seems rosy, I must assure you that it is not. For there is an unfortunate cost to the equilibrating mechanism that I have described, one that is often overlooked.

The means by which the United States will continue to export, in face of lagging productivity, is a reduction in its relative real wages. Ironically, in this process we will stay in the world markets by becoming the sort of source of cheap labor we have always feared from others. When the day comes that Japan fears competition of cheap U.S. labor, we will indeed learn how the mighty have fallen.

How does that happen? If U.S. products cannot compete because of the productivity lag, the U.S. payment deficit must rise, and the exchange rate must turn against us accordingly. This means that an hour of U.S. labor produces a product for which we get less and less foreign goods in exchange. A falling exchange rate means precisely that.

But the falling relative purchasing power of U.S. labor must necessarily mean falling relative living standards. It also threatens a general loss of purchasing power of the United States, with which to finance investments, with which to finance education and research, with which to finance programs to enhance the quality of life.

In short, the productivity lag, while it will, in the long run, not exclude the United States from the world markets, nor create chronic massive unemployment, does threaten our relative living standards, our quality of life, and ultimately threatens America's leadership itself.

I turn finally to a few words on some of the remedies that are widely proposed to deal with this issue. At this stage, I am not ready to offer a systematic program on the subject, rather, I have a more modest objective: to warn about exclusive reliance on measures widely favored, but which may well be insufficient for the purpose.

I have talked to many business persons on this subject, and many advocate a program made up of measures such as deregulation, decreased taxes on business, and effective control of inflation. No doubt there is a great deal to what they say. Regulation, particularly where it is ill-advised or ill-designed, wastes resources, delays business decisions and inhibits our growth directly.

Taxes on activities like investment, handicap that major contributor to our Nation's productivity growth. Inflation distorts capital markets, and impedes enterprise in a multitude of ways. No doubt progress on any and all of these fronts will stimulate productivity growth.

But are these by themselves enough to permit us to catch up with West Germany, let alone Japan?

It must be remembered, for example, that when the United States started to fall behind those countries in productivity growth, the inflation rate in the United States had hardly begun to rise. Moreover, it must be remembered that in Europe and Japan, business is neither completely immune from regulation nor from taxes, though I must admit that in some cases these are less onerous than ours.

Perhaps equally suggestive is the fact that Great Britain, during its long period of decline, from 1870 to 1914, had for all practical purposes no business taxes, no regulations, and no inflation.

The main point is that doubling or even tripling of our long-term rates of productivity growth is clearly no easy task. Yet, unfortunately, in this arena, no more modest goal is likely to be acceptable, unless we are reconciled to a future as a second-rate economy, with second-rate living standards, and second-rate quality of life. Otherwise, we cannot be reconciled to modest productivity growth standards. But that in turn has another implication. We will have to learn that there is no quick, easy fix. I am convinced that given our Nation's spirit, ingenuity, and enterprise, remedies are not beyond attainment, but if we are prepared to accept only measures that are painless, costless, and constitute little more than business as usual, we are in effect giving up the fight before it has even begun.

Thank you very much.

[The prepared statement of Mr. Baumol follows:]

For Release on Delivery
April 2, 1982

PRODUCTIVITY AND PROBLEMS OF TRADE

by

William F. Baumol
Professor of Economics
Princeton and New York Universities

and

Project Director
Forthcoming Policy Statement on
"Productivity Policy: Key to the Nation's Future"
for
Committee for Economic Development

before

SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY

COMMITTEE ON LABOR AND HUMAN RESOURCES

U.S. SENATE

April 2, 1982

It is a great privilege to have been invited to testify before this Committee on a subject so crucial for the future of this country. The decline in our productivity growth over the last one and a half decades and our poor standing in the growth race with a number of countries in Europe and the Far East, threatens serious consequences for this country's leadership, its position in the international marketplace and its relative standard of living.

In preparing my remarks for today I was fortunate to have had the opportunity to delve into the subject of these hearings while drafting a report of the Subcommittee on Productivity of the Committee for Economic Development. That report is now well under way and I have drawn upon it liberally in the material that follows. I am also about to embark on a study dealing with the relationship between productivity growth and scientific and technical information which, I hope, will receive support from the National Science Foundation.

Given the subjects of today's hearings I will address myself primarily to two issues, first, the measurement of productivity, and second, the implications of our productivity lag for the nation's international competitive position.

On the first of these I will conclude that there is not and cannot be any one absolutely correct way to measure productivity and its growth, any more than there can be any one ideal index of prices. However, I will suggest that this does not preclude us from drawing reliable conclusions about our productivity performance. The fact that all the available price indices during the past few years concurred in reporting that inflation was rampant enabled us to agree on the validity of that observation. Similarly, the concurrence of the different productivity indices on the unsatisfactory state of our productivity performance seems to leave little doubt on the subject, despite the absence of any perfect productivity measure.

On our international trade position I will undertake to dispel one basic misunderstanding. It seems to be widely believed that lagging productivity will harm the U.S. by subjecting it to ever growing trade deficits and declining exports relative to imports, as we are driven out of one market after another. Actually, in the long run neither of these consequences -- indefinitely growing deficits nor gradual exclusion from the export market -- can possibly occur. Rather, the real penalty the U.S. will suffer is much more serious in substance, if not in form. The result of lagging productivity must be that our standard of living and the purchasing power of our wages must fall further and further behind those of countries which beat us in the race for productivity growth. Ultimately, we will be driven into a most unenviable position -- we will keep a place on the international market by virtue of our one remaining asset under this scenario -- our comparatively underpaid labor force. We will then become the source of what other countries will regard as "cheap foreign labor," exporting the low quality products which such a labor force is fit to produce.

Of course, this does not have to happen. It is not our manifest destiny, and, I am confident, it is not our destiny at all. However, avoidance of that fate will not be easy, and the history of England suggests that it will not be avoided by complaisant reliance on the practices and traditions of the past.

On Measurement of the Productivity Problem

There simply is no one correct definition of the term "productivity," and, consequently, there is no one correct way to measure its growth. Each investigator must choose among a variety of defensible concepts and procedures.

Here it must be recognized, to begin with, that there are two primary measures of productivity: labor productivity and total factor productivity. The first measures how much of the nation's output is produced by an average member of the labor force. Roughly speaking, it is obtained by dividing total output by the number of persons in the labor force. Total factor productivity, on the other hand, seeks to measure not only the contribution of labor alone but also that of all other inputs taken as a group, including capital, raw materials, etc.

There is a sense in which the latter must be considered the more illuminating and pertinent measure. After all, while labor is perhaps the most important single input, as is suggested by the fact that wages constitute some two-thirds of national income, it is by no means the only contributor to our economy's production. Without raw materials labor could produce little if any output, and without capital and management it would undoubtedly produce much less than it does. Even a diminution of skills and the outlay of effort of workers could conceivably be made up for by an acceleration in the productivity of other inputs. It is important, therefore, in analyzing the state of the economy, to take all inputs into account, and that is what an index of total factor productivity seeks to do.

Yet, one should not leap to rejection of the labor productivity measure as a crude and perhaps tendentious simplification. There are many important reasons for continued use of this criterion, some conceptual, some a matter of practicality. First, it should be recognized that there is one fundamental insight which is provided more effectively by a labor productivity measure than it can be by any index of total factor productivity. The nation's standard of living depends on the rewards received by its human inputs. That is, if the size of the labor force were to grow roughly in step with the size of the nation's population,[1] then movements in output per capita would have to parallel those in output per worker. A country whose labor productivity is high will be one whose standard of living is high.

Thus, each productivity measure has its legitimate purpose, and neither can be rejected as clearly less significant than the other. As already mentioned, there are other reasons favoring the labor productivity measure which make it likely that most statisticians working in the area will continue to use this concept. One problem besetting the use of total factor productivity is that it is far more difficult to measure than labor productivity. The fundamental difficulty besetting all indices of productivity is their innate incompatability with anything like precise measurement. The indices must, by their very nature, aggregate very heterogeneous entities -- they must each, at every step of their calculations, deliberately commit the sin of adding apples and bananas. If we are to divide the nation's total output by the number of persons in the labor force, we must first add up all of the many different goods and services that the economy produces. This is usually done by employing the GNP, or net national product, as the measure of output. It is then necessary to divide the resulting index by another heterogeneous aggregate, the size of the labor force. For it is no more legitimate to add three hours of a bricklayer's efforts to six hours spent by a skilled machinist and two hours of a research scientist than it is to add outputs of cars, wheat and medical services.

---

[1] This is not quite so in fact. The share of the population participating in the labor force has been rising since the 1960s.

But total factor productivity runs into a heterogeneity problem which is still more serious. The diversity of, say, a raw material and an hour of some sort of labor is even greater than that between one type of labor and another. Measurement of true depreciation and calculation of the services of capital (as contrasted with its overall quantity) in order to obtain a figure for this input that is comparable with the labor input datum, the flow of services of labor, clearly is not easy, to say the least.

Indeed, the resulting problems and ambiguities have raised serious questions about most of the calculations of total factor productivity that have so far appeared.

There are many other difficulties which beset the measurement of productivity. For example, there is no obvious and valid way to measure for any particular economic sector or any particular industry, the absolute level of its total factor productivity in contradistinction to its rate of growth. The problem arises because in order to add up an industry's various inputs, both inputs and outputs must be measured in money values. But, then, the productivity measure must be defined as the value of the industry's output divided by the value of the industry's inputs. It follows that if two industries earn the same rate of profit, their calculated absolute productivities will be the same. And this will continue to be so even if physical productivity in one of the industries has been relatively static while in the other it has been growing briskly year after year. This shows that interindustry productivity comparisons are, at best, difficult and, at worst, quite treacherous.

As already emphasized, these measurement problems are inherent in the concept of productivity, and there is no reason to expect that they will be eliminated by more careful work or by future research. Fortunately, the usefulness of productivity measurement does not rest on any hope that these difficulties can be eliminated. Rather, it is firmly grounded on experience, which confirms that in most cases the different methods of measurement of productivity yield results which are entirely consistent.[2]

In saying this it should be emphasized that we are not asserting that any particular measure of productivity is largely beyond criticism. Indeed, the difficulty is inherent in the problem because any productivity measure seeks to use a single number to describe the performance of a large number of heterogeneous outputs in producting an even wider variety of products. There is, of course, no way in which any single number can describe the behavior of such a multiplicity of variables with any degree of accuracy. In the end one is perhaps driven to say that the only thing worse than an attempt to measure the growth of productivity is failure to do so.

Productivity Vs. International Competitive Position

In the international marketplace U.S. industry is already beginning to feel the handicap of our lagging productivity growth. In the sixties and seventies a number of American industries have found it difficult to retain their earlier shares of foreign markets. Moreover, they have witnessed successful invasion of the U.S. by foreign products, with imports of automobiles, television and radio equipment and cameras constituting only some of the most obvious examples.

---

[2] For excellent discussions of the conceptual problems and measurement issues associated with productivity, see Albert Rees, "Improving Productivity Measurement," American Economic Review 70 (May 1980), pp. 34-42 and the same author's "Improving the Concepts and Techniques of Productivity Measurement" in Bureau of Labor Statistics, Monthly Labor Review, September 1979, pp. 23-27.

It has been charged that this invasion is in part attributable to more or less hidden export subsidies by foreign governments, and that U.S. industry's export problems are partly ascribable to various types of restrictions and impediments which other countries have imposed upon imports from the U.S. The significance of these influences has been subject to some disagreement, but whatever the validity of the charges it seems clear that they do not constitute the entire problem, and that U.S. industry has found itself increasingly handicapped in the competitive race by its lagging productivity performance and the rising relative costs that accompany it.

It is tempting to conclude from such observations that unless this country succeeds in catching up to its competitors in terms of productivity growth, U.S. industry is fated to be driven out of foreign markets and to have much of its home market taken over by producers in other countries. One is led to conjure up a vision of a growing and chronic balance of payments disequilibrium with this country finding it ever harder to earn the foreign exchange necessary to pay for the imports it requires.

However, economic analysis tells us that, at least in the long run, this simply cannot happen. It shows that even if the U.S. were to end up being less proficient than other countries in the production of literally each and every one of its outputs, it would still pay other countries to import products from us. Moreover, there are forces which will drive the long-run balance of payments toward equilibrium, so that the value of American exports must ultimately tend toward equality with the value of its imports no matter how miserable its productivity performance. Lest these conclusions appear to be comforting it should be made clear that in such circumstances the promised equilibrium in exports and imports will incur a cost most of us are likely to consider unacceptable -- it will be achieved at the expense of a drastic reduction of the American standard of living, at least relative to that which prevails in the rest of the world.

Ricardo's law of comparative advantage long ago showed that even a country whose poor productivity renders it the less efficient producer of each and every one of its goods will nevertheless not be driven from the international marketplace. It will still pay more for the efficient nations to purchase from the productivity laggard those goods in whose manufacture it is less inefficient. For that enables the efficient countries to specialize, devoting their resources largely to the production of those items which they produce best.

An analogy can be used to bring out the reason: it will generally pay a computer expert to hire someone else to do her key punching, even though she can do the punching faster and more accurately herself. This is so because her time is too valuable to waste on that task. Using exactly the same reasoning, the law of comparative advantage proves that it is advantageous for more efficient countries to specialize in producing those things at which its efficiency is most exceptional rather than wasting its resources on the production of items which other countries can supply with relatively modest inefficiency. For this reason no country, whatever its inefficiency, will ever be driven from the international marketplace. True, it may find itself left, as it were, with the crumbs, confined to the production of items, in effect, disdained by its more efficient rivals. But it can be confident that a niche in the market will nevertheless remain to it. Indeed, economic analysis tells us more than this. It shows that in the long run such a country will be enabled by market forces to export enough to achieve equilibrium in its balance of payments. Despite its inefficiencies, it will be able to sell enough to cover all its bills.

Economists since before David Hume and Adam Smith have called our attention to a variety of equilibrating mechanisms which prevent the indefinite continuation of a balance of payments disequilibrium. To illustrate the workings of these mechanisms, consider two "trading partners" -- one country, S, which has been enjoying a surplus in its payments and a second country, D, which has been experiencing a deficit. Country S's prices and incomes will both automatically be driven upward by that country's surplus. The rise in income, in turn, will give residents of surplus country S the means to increase their imports from deficit country D. Moreover, the rise of prices in S (and the accompanying fall in prices in D) will automatically make it more attractive for residents of country S to make their purchases in D. Simultaneously, in deficit country D incomes and prices will fall, and so residents of D will find it less and less attractive to buy goods and services from S. If this adjustment is not sufficient to restore equilibrium prices and incomes in S will rise further and the opposite will occur in D. This process will go just as far as is necessary to eliminate the imbalance of payments.

In the contemporary world with its relatively flexible exchange rates still another component is added to this mechanism -- a component which does its work rather rapidly. For nowadays the exchange value of the currency of surplus country S will be bid up by the forces of demand and supply as importers of its products seek to acquire enough country S currency to enable them to pay their bills. The reverse will be true of the value of the currency of deficit country D. This, too, will make S's exports more expensive and reduce the cost of D's products to residents of other countries. It will thereby encourage the shift in demand from the products of S to the products of D. These three automatic adjustments -- in relative income, in domestic prices and in exchange rates -- will automatically be continued by market forces until balance of payments equilibrium is restored.

But while balance of payments disequilibrium is self terminating, at least eventually, the nature of the cure is certainly painful enough. We have already noted that it involves decreasing incomes in the deficit countries. This is aggravated by the accompanying changes in prices and exchange rates for the deficit and surplus countries, for each of these changes means that the deficit country sells its export products more cheaply and buys its imports at higher prices. Thus, measured in terms of the commodities it acquires from abroad in exchange for its labor, it means that the deficit country must reconcile itself to receiving smaller and smaller quantities of goods and services in exchange for its labor until the real price of its labor falls sufficiently low to restore that country's international competitiveness. Equilibrium is indeed restored -- but at the expense of relative wages and of the country's comparative standard of living.

The adjustment processes are, of course, not easy ones, and the transition from a high-wage prosperous country to one whose main competitive edge is relatively cheap labor can be slow and painful. The nation is also likely to be handicapped in this process by other countries' impediments to freedom of trade -- their reluctance to accept imports from our country, and the special and inappropriate advantages they grant to the things they export to us. In the long run, things still must work out in the general manner already described. But restrictions on free trade will make the transition more difficult for us and may lead to a variety of particular distortions in the final outcome.

This, in broad outline, is the process whereby a country which lags in the productivity race is assigned a new position in the world economy, one commersurate with its mediocre productivity performance. This outline has omitted some of the details. For example, nothing has been said about the process by which the country's product mix and its input proportions are modified. We need only note that mobility of capital means that the cost of capital to a deficit country will not fall along with the real wages of its labor force. Consequently, for such a country capital will become relatively expensive in comparison with labor, and it will therefore grow less profitable to produce goods with heavy capital requirements. There may also follow a reduction in the amount of expensive and sophisticated equipment provided per worker, further exacerbating the productivity handicap of the deficit country.

In sum, though it will not be driven from the world's market or subjected to chronic and incurable deficits, the foreign trade prospects for a country that lags in the productivity race are nevertheless hardly attractive. It will pay for its inefficiency by getting less in exchange for its exports, by being forced to see its living standards fall behind, and by being driven from the ranks of the world's leading nations. History provides examples of a number of nations which have suffered that fate.

Concluding Comment

The picture I have painted here of the nation's economic future in the event its lag in productivity growth persists very much longer, is not an edifying one. It is therefore important to reemphasize that this fate is by no means sealed. Indeed, the outcome remains very much in our hands. It is not the purpose of the preceding analysis to encourage fatalism and despair, but to emphasize the urgency of the issue and the need to get used to the idea that it calls for more than appeals to patriotism and slight modifications in business as usual.

Senator **Quayle**. Thank you very much.

Mr. Norsworthy.

Mr. **Norsworthy**. Thank you, Senator.

I am pleased to participate in these hearings today on productivity in international competitiveness.

My discussion is based primarily on research findings where we studied manufacturing in the United States and in Japan.

I will summarize briefly some of the points in my written testimony.

Senator **Quayle**. Your full testimony will be in the record.

Mr. **Norsworthy**. Thank you.

We have studied productivity growth in the manufacturing sectors of the United States and Japan. It is productivity in manufacturing that is most important for international competitiveness, and it is Japan whose manufactured products are competing most successfully with domestic production here in the United States, and also in many other countries.

In table 1, on page 3 of my testimony, you can see the labor productivity growth in the United States and several other countries over the last 20 years. The growth rate is lowest, both before and after 1973, in the United States. Japan's rate of growth is highest in both periods.

All countries, in their manufacturing sector, showed a decline in productivity growth after 1973. These are the basic facts.

Now, labor productivity is the most common productivity measure that we hear about, and before 1973 only specialists discussed other productivity measures to any great extent. But since 1973, much more attention has been paid to multifactor productivity measurements and multifactor productivity growth.

There are two common varieties of multifactor productivity measures: Those that cover only capital and labor, and those that are based on all purchased inputs. Our study of Japan covers four major categories of inputs: capital, labor, energy, and materials. The last category is a catch-all for everything else.

Table 2 shows the productivity growth rate of all four input factors, as well as the growth in multifactor productivity. This is the average growth rate of the productivity of all input factors combined. It can be thought of as an average of the productivity growth rates of labor and capital and energy, and so forth, appropriately weighted.

There are two important notes to note in table 2. First, labor productivity growth in Japan has been much more rapid than in the United States: about 11 percent per year, against 2½ percent before 1973, and about 5½ percent against 1.8 percent after 1973.

Second, the overall efficient level of production as measured by multifactor productivity increased only a little faster in Japan than in the United States. That result is somewhat surprising, at least it was to me.

If overall efficiency, or multifactor productivity was rising rather slowly, where did the very high growth rate in Japan's productivity come from? The answer to that question comes in two parts.

First, we will look at the pattern of input growth in table 3, and then at some of the sources of productivity growth in table 4.

Table 3, on page 12 of my testimony, shows the growth rate of all the factors of production, as well as the growth rate of output. In every case, we see an important slowdown after 1973.

Let us compare the growth rate of labor input in each country with the growth rate of the other input. Capital energy, and materials, in the United States, the labor input grows somewhat more slowly than the other. But look at Japan. Capital, energy, and materials are all growing much faster than the labor input. Surely, this is an important part of the story.

Now, in table 4, which is on page 14, we can see a systematic way to take all of this into account. We can unify labor productivity and multifactor productivity in the same framework. We express labor productivity growth as the result of two kinds of forces: growth in overall efficiency, as measured by multifactor productivity growth; and growth in the intensity of the other factors used with labor in production. Briefly then, what table 4 shows us is that in the United States, in the 1965–73 period, most of the growth in labor productivity came from growth in the intensity of other factors. All but one-half of 1 percent, in fact, of the growth in labor productivity was due to increasing intensity of capital, energy and materials. About one-half of 1 percent was due to overall efficiency growth, measured as growth in multifactor productivity.

In Japan, for that same time period, the growth in intensity of capital alone contributed 3.9 percent to labor productivity growth, and the growth rate of the other factors were also very substantial. These intensity measures are derived in a measurement sense from the ratios of capital to labor, energy to labor, and materials to labor.

This growth in the intensity of the other factors in the production process relative to labor, has been the source of the productivity miracle in Japan, a very large increase in the capital and materials per worker.

In summary terms, there is a dramatic change in the methods of production, but not really a miracle. More capital, enabling the worker to process more materials, but nothing very mysterious at all in the way we generally look at the production process.

What about the widely discussed dedication and motivation of the Japanese worker? Well, if that were the major source of rapid productivity growth, we might expect to see greater growth in overall efficiency in Japan, in multifactor productivity. The role of good labor relations should not be discounted, however. Labor policy can play an important role in gaining acceptance of rapidly changing technology.

In brief summary, a close examination of productivity growth in the United States and Japan suggests a very conventional explanation for the differences.

More rapid investment per worker, joined with rapid growth in materials process per worker has led to substantially higher productivity growth, and has certainly contributed to increasing competitive Japanese goods in the United States and other markets.

The miracle, if there is one, probably lies in raising and sustaining capital investments, and in effectively introducing new technology.

Before I terminate, I want to come back, Senator, to the point that you made earlier about total factor, or multifactor productivity measures for the entire economy.

At present, the Bureau of Labor Statistics is developing those measures, in fact, for the aggregate sectors: private business and nonfarm business. We will begin to publish multifactor measures based on the capital and labor inputs sometime late this year.

We expect next year to follow up with multifactor productivity measures for the manufacturing sector—based on capital, labor, and energy and materials as well. That will, as I say, take place sometime next year.

Senator QUAYLE. So you will be expanding the productivity data into the multifactor basis?

Mr. NORSWORTHY. Yes.

Senator QUAYLE. Will you combine manufacturing and services, or will it just be primarily for manufacturing? How encompassing is it going to be?

Mr. NORSWORTHY. The private sector measure will encompass, in general, everything except Government and the output of nonprofit institutions. We also take out that part of the GNP, which is the computed value of owner-occupied dwellings, that is because we do not have the labor input to go with it. But in general we cover about 75 to 80 percent of GNP in the private business sector measure.

The other major set of measures will be, as I said, in manufacturing, where we will look at all purchased inputs, capital, labor, and materials.

Subsequently, we will also look at individual industry sectors, within manufacturing. A constraining problem in developing new measures is that we rely primarily on data which are developed for other purposes. The capital data, for example, does not permit very much detail at all, as among the various industrial sectors. We do not have regular measures of capital, for example, for services or retail trade or transportation.

Senator QUAYLE. Were you in the room when the other two panelists, Mr. Rees and Mr. Gollop, talked about the total productivity factor?

Mr. NORSWORTHY. Yes.

Senator QUAYLE. This new factor that you are talking about, releasing, do you believe that is—or does that address their concerns or is this somewhere in between that? It seems to me that is precisely what we are talking about, is that a fair summary?

Mr. NORSWORTHY. Yes.

Senator QUAYLE. I think that is very important, and I am glad you are going to do it.

I wonder what kind of process you are going to go through to get there. You know, there is a lot of dispute between the two of them.

I am sure Dr. Baumol might be able to talk on this, too, about the measurements. But to get us on a standard, a baseline of what we can talk about, what kinds of process are you going to go through, and how are you going to highlight this so everyone will now know that this new factor is coming on?

To me, and from the hearings that I have had so far, I think it would be a very important factor. I think it would be very important, and I wonder if you might be able to explore with me the process you are going to go through in the first release of this.

Mr. **Norsworthy**. What we normally do when we introduce new measures, is to release at the same time, a detailed set of technical papers, describing how we developed the measures, stating their limitations, inviting criticisms and suggestions.

Typically, as in fact we have done some in the last several years, we will discuss these issues with researchers in the private sector and in universities.

By this process we hope to achieve a measure which we keep, in a technical sense, as current as possible. An important part, I think, of our introducing this new measure will be to join the labor productivity and the multifactor productivity measure in a common framework, such as was represented in table 4 of my testimony.

In that unified framework, one can examine the growth in labor productivity as resulting from changes in multifactor productivity and changes in the intensity of capital and energy and materials relative to labor.

I think that is a useful way to look at the two measures because it is ultimately labor productivity that determines how fast the standard of living can grow.

On the other hand, from the perspective of international competitiveness, multifactor productivity, is the critical measure. But now there is an important caveat associated with this: it is not only the efficiency of using all resources—that is multifactor productivity—in producing output, that is important. The exchange rate as Professor Baumol pointed out, is very important, and changes in the exchange rate, of course, can substantially change the trading balance, the competitiveness of goods, even though productivity levels are comparable.

Mr. **Baumol**. In fact, we will automatically do so, to some degree. That is the nature of the competitive mechanism. I must say, I agree with everything Dr. Norsworthy said, and the moral I draw from this is that with experts such as he, getting the advice of others in the profession I have complete confidence that they will come up with a measure that is reasonable, which is precisely what is hoped for.

As I have said, there is no one right measure. The people who have lived and worked with measures and who know what is required for comparability for consistency, in, say, the measure of labor productivity, are the ones who should design them to be workable, and having done that, so long as not too much is claimed for them, as has not been done, I am more than happy with the results that I am sure will emerge.

Senator **Quayle**. I would certainly concur, and just offer any assistance that we can give, to make sure that you have all the contributions, those that want to contribute, on how this ought to be arrived at. I think that the more open and more inputs you have, whatever the conclusions at which you arrive, people are going to say okay, that is the best consensus arrangement that we can work out, and I hope that it does proceed along those lines, and in a not too distant future.

I think sometimes you get yourself in a position, particularly on disagreements, that there is a tendency to put it off. I would encourage you not to put it off, but as you proceed down this process, to be as open as you can, and receptive to inputs from the people who have their own ideas.

Mr. **Norsworthy**. I think we will not achieve total consensus, but on the major outlines I think there is very little disagreement. It is certainly well within that framework of consensus that the measures will be prepared.

Senator **Quayle**. There is no consensus among economists, politicians, or even farmers. But I am sure that we can come to a common agreement.

First of all, that something ought to be done, and this will be very, very helpful to us all.

I was listening to Mr. Baumol's discussion and conclusion, I believe I jotted this down, that the UK's decline between 1870 and 1914, that they had no inflation, no taxes, and I forget what——

Mr. **Baumol**. No regulation.

Senator **Quayle**. Yet you had this decline in productivity. Is there a comparison you want to make with that historical note, with what we are seeing right now in the United States as far as the decline of productivity?

I was struck by the example that you used there. I want to know what the relationship is.

Mr. **Baumol**. Well, these things are always very hard to disentangle. I can draw all sorts of parallels, such as statements from the period which are disturbingly similar to some statements I have recently heard; "it is all a matter of measurement," or "it is all because the Japanese are catching up to us, and once they have caught up it will all be over"—things of that sort. Then one heard instead that "good old British workmanship will muddle through." I can cite too many examples from that period, and I can cite too many examples today.

But there are other things which were very different, and I do not think one can operate simply by historical analogy. I think what is important in the analogy is what I have extracted by that point I made about inflation, and regulation and taxation of business. That is to say, those sources of productivity decline were absent in Great Britain. Yet, to the extent that we can trust the data, the rate of growth declined then as it has here today, and the data also indicate that Britain's productivity growth had fallen behind that of Germany and the United States, just as ours has fallen behind that of Japan, and a number of other industrial countries.

But these things can happen, despite favorable conditions in terms of those three elements alone. All that means is we must beware of saying that it is enough to do everything which businessmen and women, for good reasons, would like to see happen. Though these alone may do various good things for the economy, and help us to move toward a reasonable productivity performance, to rely on them exclusively, I think is self delusion.

Senator **Quayle**. You also indicated that there is no painless way, no quick fix, to get back to seeing an enhancement to productivity.

Do you believe that from a Federal Government perspective, that is the only thing that I can deal with, that we are headed in the right direction on our economic policies, our tax policies?

What do you think that we, as a Congress, could do to enhance productivity in the decade of the 1980's, or do you believe that our actions, as you interpret them now, are on the right road?

Mr. **Baumol.** I would say, in many ways they are going in the right direction, but I think if I may almost speak in slogans, that while supply side economics has moved to stimulate supply in the short and intermediate run, and has appropriately focused on these very pressing immediate problems, it has in its design not paid enough attention yet to the longer run problems, the problems of the decades ahead.

The general feeling has been that a mere reduction in the burden of taxation on business, and on consumers, will stimulate enough addition in the spirit of workmanship, entrepreneurship, et cetera, to get us out of our problem.

But if I may suggest an analogy, if we were dealing with an inadequate performance of a firm's sales force, it would be as though we had said let us double the hourly wages of the sales force, and hope that thereby we will get a sufficient increase in dedication for the purpose. Generally no businessman would operate in that way. Rather, what he would do, was insist on something involving payment by results. That is to say, with the sales force, the way you would elicit greater effort is by tying compensation to performance. I think that is appropriate there, and I think in some way it will ultimately prove appropriate here. That is to say, the tax cuts that have been offered to business, have not been offered in such a way that their benefits depend upon the long-term performance of the firm, and I think that is the direction in which we will have to start thinking.

Senator **Quayle.** What kinds of concepts in the area of taxation should we be exploring as incentive to have business respond in long-term fashion, rather than short-term?

Mr. **Baumol.** That is precisely the issue I am now struggling with, and I hope I will have an opportunity, a few months from now, to talk further on the subject. But these are the general lines along which I am thinking.

Senator **Quayle.** Today we have had four very distinguished panel members talk about productivity, talk about taxes, we talked about inflation, we talked about the decline in productivity, but during—it has been almost 2 hours, I do not believe that I have heard a word, or the discussion of the impact of interest rates on productivity.

I am just sitting here thinking to myself that I have not heard that yet. I just wonder if the two of you might want to comment on the—in my opinion, the intolerably high interest rates, the gap that we now have in interest rates, between prime and inflation, and if in fact you think on a short term or long term that it will have an impact on productivity?

Mr. **Norsworthy.** I think, along those lines, just on a technical point, Professor Baumol mentioned the equilibrating mechanism that tends to take place when one's country productivity level is below that of another, that there will be an adverse balance of payments, and exchange rates will adjust, and so on.

I am not, by any means, an expert on international finance. But I believe it is the case if the country where productivity is very low, and the interest rate is high, that high rate will retard the adjustment of the exchange rates, by encouraging flows, financial flows, capital flows from the higher to the lower productivity country.

So as long as we have extremely high interest rates, there will be a tendency to extend the adjustment period for exchange rates beyond that which would normally take place, based only on the different productivity levels.

Mr. **Baumol**. I agree with that, of course, but I also agree with something that Dr. Norsworth emphasized in his paper as being even more important, and that is the differences in levels of investment, in Japan, and elsewhere, compared to the United States.

I also gave some figures roughly indicating the same sort of thing, though not nearly as profound. I think it is crucial if we are to get anywhere in the productivity race that investments be encouraged, and surely nothing discourages investments more effectively than high, real interest rates.

As you have said, Senator, our real interest rates are unprecedented, and surely they must constitute a very serious impediment to investment, which not only reduces the amount of capital per worker relative to other countries, at least in the future, in comparison with today, but it also makes our capital stock more obsolete. It enables them to have more recent models than we do, it enables their models to encompass, and indeed, to stimulate innovation, so in all respects, I cannot agree more that the high interest rates are one of the manifestations of inflation which surely will inhibit our dealing with the productivity problem very effectively.

Senator **Quayle**. One final question.

If you had to identify one thing, or area, that the Congress could do in this session, between now and October the first, what would you recommend that we turn our attention to, and try to accomplish in an effort to make the potential enhancement of productivity possible?

Is there one area? I know it is difficult, and I know you being very intelligent and intellectual individuals do not like to simplify things. But if we could sort of zero in on what that one particular thing that we could in fact be turning our attention to, what would it be?

Mr. **Baumol**. I hate to take on any one. I could pick two, three or four, perhaps.

Senator **Quayle**. How about two?

Mr. **Baumol**. All right.

One of the things which is going to be a very painful issue is the encouragement of savings, as against expenditures, by consumers.

In the United States, as compared to most other countries, we have greater encouragement of consumer credit, we have greater encouragement of investment in housing, as against productive facilities, we have all those things which your constituents, and everyone elses' constituents are not going to be happy about your changing.

I have said that effective measures are going to be painful, and painful to everyone, including me, as a homeowner, but we profiles in courage will have to include more people if we are to get where we want to be going in this direction.

The second area, as I have already hinted, is reexamination of the structure of tax benefits that we are offering to industries. I see everything to be said in favor of the magnitude of those tax benefits, but I feel that the long-term incentives built into those tax reductions have not been thought through properly, and one should, as soon as possible, begin investigating how those tax reductions can be structured so as to give the maximum incentives for investment, for switching out of activities in which productivity growth is difficult into activities in which productivity growth is very promising, for the encouragement of means of compensation to the labor force by industry, which will make it easier for workers to accept innovation. All these things by incentives to industry will ultimately force industry operating through the market mechanism, to do for itself.

Senator **Quayle**. Mr. Norsworthy.

Mr. **Norsworthy**. I would add one important point. It is something I feel more comfortable in discussing, if I take off my civil servant hat.

I think we have a very important and challenging adjustment process ahead in the United States, associated with retraining workers, to accommodate the transition, from what appears to be declining sectors, to growing sectors.

There is a difference in skill mix, and very often a difference in physical location that has to be dealt with. I am not certain at all what the appropriate way would be to go about this, but I think the problem itself is one that should and could well be examined with great care.

Senator **Quayle**. I can just tell you, as the chairman of the Productivity Committee, and other issues, that we have been working on the training legislation, and one of the new elements is to deal with this dislocated worker, the individual who has no real opportunity to go back to his or her recent place of employment.

I see it in Indiana, where we have a declining auto industry, and even the Commerce Department, under almost a best case scenario, states that perhaps 600,000 workers directly or indirectly, are not going to go back to their place of employment, and as we get into new technology, our education system, and other systems we have, are going to have to direct themselves toward this new set of problems and worker needs that is coming on line.

I mentioned in my opening statement concerning robotics, that this is a whole new industry in our society that will change the way America works. It's not going to affect merely the workers just entering the work force but workers already employed will be affected and will need retraining as well. I believe that the legislation I have introduced deals with that, but the problem it addresses is only in its initial stages.

So, I think the point is very well taken.

Gentlemen, I thank both of you. I enjoyed this testimony, I enjoyed working with you in the past, and I look forward to future communication of mutual concerns.

Thank you very much.

[The prepared statement of Mr. Norsworthy follows:]

Recent Productivity Trends in the U.S. and Japan

by: J. R. Norsworthy
Chief, Division of Productivity Research
Office of Productivity and Technology
Bureau of Labor Statistics

I am pleased to have the opportunity to participate in these hearings today. My discussion is based primarily on research findings, rather than on official BLS statistics because we are only just developing official measures of capital, energy and materials inputs for the manufacturing sector. When that development of the new measures is complete, the final data will look somewhat different from those I present today. The general trends in U.S. manufacturing, and the comparison with Japan will probably not change markedly. The unofficial results from research studies do provide a broader basis for analysis of productivity trends in the U.S. and Japan.

The research on which most of my discussion is based is reported in preliminary form in "Input Measurement in Japanese and U.S. Manufacturing", a paper written by my colleague Dr. David Malmquist and me.

Table 1 shows the growth in labor productivity in manufacturing for the U.S. and six western industrialized nations before and after 1973.[1] All countries show a slowdown in productivity growth after 1973. France and West Germany show smaller impacts than other countries. Japan, even after a significant slowdown--the largest in the table--still leads the countries shown in productivity growth after 1973. This productivity performance was a major reason for our wanting to compare U.S. productivity experience with that of Japan.

I. Background

The Bureau of Labor Statistics is currently developing multifactor productivity measures for major sectors of the U.S. economy and for selected industries. For the manufacturing sector, four major categories of inputs will be recognized: capital, labor, energy and materials. Our research efforts to support this program and to resolve certain measurement and conceptual issues have included an analysis of output and input measurement and productivity growth in U.S. and Japanese manufacturing. Japan was chosen for comparison purposes because the growth of productivity there has been extraordinary. And, the U.S. and Japanese productivity growth experiences in the last 15 years or so lie at opposite ends of the spectrum of western industrialized countries' productivity performances, as is clear in Table 1.

It is important at the outset to clear away a few technical points that are important.

First, our study has examined productivity growth, rather than productivity levels. It is much harder to compare productivity levels between countries with different currencies, different business environments and different technologies. While U.S. productivity growth in manufacturing has been much lower than Japan's, the levels of productivity are probably not very far apart. We will analyze some of the sources of the different rates of productivity growth in the U.S. and Japan.

Table 1. Productivity Growth in Selected Countries 1960-80
Average Annual Rates

	1960-73	1973-80
United States	3.4	1.3
Canada	4.7	1.5
Japan	10.5	6.4
France	5.8	4.4
West Germany	5.5	4.5
United Kingdom	4.3	1.6
Italy	7.3	3.8

Source: Bureau of Labor Statistics

Second, we will discuss in several places what is commonly called multifactor or total factor productivity. This measure represents the productivity performance of all factors combined--in this case, labor, capital, energy and materials. While a consensus has emerged in the economics literature about the general framework for adding together the separate inputs to productivity in order to create a multifactor productivity measure, researchers differ on some details of application. Again in this instance, interpretation of U.S.-Japanese productivity trends would not be sensitive to alternative practices within the commonly used framework for productivity analysis.

The following discussion of U.S. and Japanese productivity growth is based on a different output measurement concept from Table 1, which is based on the GNP accounts of the several countries. We used the gross output concept because we wanted to examine the roles of energy and materials in the two countries as well as those of labor and capital. A gross output approach permits us to look at all purchased inputs, whereas GNP accounting methods net out all but labor and capital.

The time periods covered in this presentation are 1965-78 for Japan and 1965-77 for the U.S. Earlier data are available for the U.S., but our study of Japan carried the series back only to 1965. Because the U.S. data have not been updated beyond 1977, the full recovery from the 1974-75 recession may not be reflected in the 1973-77 time period for the U.S. This effect probably biases downward the growth rates of capital and energy productivity in the last time period.

II. Trends in Productivity Growth

This multifactor productivity measure used here should be thought of as a supplement to the conventional labor productivity measure that BLS has published since the early 1960's. In fact, as Table 2. shows, the growth in the productivity of all factors combined--multifactor productivity growth--can be thought of as an average of the productivity growth rates of the several factors of production: labor, capital, energy and materials. In Table 2, let us look first at the growth of labor productivity in the U.S. and Japan: the rate is about two and one half percent per year for the U.S. in 1965-73, as against more than 11 percent per year for Japan. This enormous difference in labor productivity growth is accompanied by declining capital productivity in each country. The decline in capital productivity is small in the U.S., but is about four percent per year in Japan. How could Japan afford declining capital productivity?

Table 2. Productivity Measures in U.S. and Japanese Manufacturing:
Capital, Labor, Energy, and Materials
Gross Output Basis
Average Annual Rates of Growth

Years	Multifactor Productivity		Capital Productivity		Labor Productivity		Energy Productivity		Materials Productivity	
	U.S	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan
1965-73	0.54	0.79	-0.49	-4.08	2.45	11.08	0.05	1.49	-0.13	1.0
1973-78*	0.33	1.43	-1.98	-0.15	1.83	5.42	-0.71	3.27	0.00	1.1

* Data for the U.S. are 1973-77

Source: Unofficial research results from J. R. Norsworthy and David H. Malmquist, "Input Measurement in Japanese and U.S. Manufacturing."

The answer is that even though capital productivity was declining, the productivity of all inputs combined--multifactor productivity--was rising. Taken together, the productivity of all factors rose at about 0.8 percent per year in 1965-73, not much more than in the U.S. It was in labor productivity that Japan made tremendous gains.

Continuing in Table 2, we see that energy productivity grows very little in the U.S. and at about one and one half percent per year in Japan during 1965-73. In materials--which account for about 60 percent of the total cost of production in each country--productivity declines slightly in the U.S. and rises at a one percent rate in Japan.

Taken together, the rates of productivity growth for the several inputs for both the U.S. and Japan tell us that each country is directing its efforts toward raising labor productivity more than that of other factors. Now since it is labor productivity that ultimately determines the standard of living in a country, it is gratifying to see that labor productivity growth is leading in this way. But the probable reason for the more rapid growth of labor productivity is a mundane one--the price of labor services was rising more rapidly in each country than the prices of other factors of production. Under these circumstances, we would expect producers to try to raise labor productivity by using more of other input factors--capital, energy and materials--and less labor input. And that appears to be what happened, both in Japan and in the U.S.

Now in 1973, the energy crisis occurred--energy prices rose rapidly, and for a while there were fuel shortages as well. Both the U.S. and Japanese manufacturing sectors were heavily impacted--the same is true of other industrialized countries. Two kinds of effects came to bear on the economies of both countries: price effects associated with the surge in energy prices, and output effects from the recession that swept most industrial nations.

These price effects took shape in immediate rises in energy costs where price controls were not imposed--Japan is one such country--and transportation costs, domestic and international, rose also. Where some non-market rationing of energy supplies took place--as in the U.S. and Canada--fuel and transport cost did not rise as rapidly, but the adjustment process correspondingly was extended in time. As the energy prices worked themselves through the economy, the costs of energy-intensive goods--certain raw materials, aluminum and steel--were impacted next and finally the prices of other goods and services. Feeding back through cost of living increases, the general surge in prices acquired its own momentum.

So there were two types of price effects at work in the post-1973 period: sharp rises in energy prices; and a general price inflation. Because of different general economic conditions and tax institutions in the two countries, similar price effects had somewhat different consequences for productivity growth.

One effect of energy price increases was to reduce investment in capital goods. This proposition, which has been explored independently by Professor Dale W. Jorgenson[2] at Harvard and Professor Ernst Berndt at MIT,[3] is somewhat subtle but is is important. Energy and capital are complements in the production process--that is, they are used in close conjunction with each other, like bread and butter: when capital input rises, so does the associated energy input. Since the sharp rise in energy prices discouraged energy use, it also discouraged the use of the complementary good, capital.

The normal relationship between factors of production is substitution, rather than complementarity. When two goods are substitutes, the quantities used in production of a fixed level of output tend to move in opposite directions. Capital and labor are normally substitutes: an increase in the price of labor will encourage greater use of capital, and vice versa.

So the rise in the price of energy encouraged U.S. producers to use less energy and also less capital. Because studies of the capital energy relationship have not been done for Japan, we do not know whether the same mechanism was at work there.

The general price inflation also discouraged capital formation. In the U.S. there have been two aspects to the negative effects. First, inflation has led to higher interest rates and thus has raised the cost of funds for capital investment. At the same time, rising prices of capital goods raised the cost of replacing the capital stock, while depreciation for tax purposes continued to be based on historical costs, the acquisition cost of the assets. Because economic depreciation exceeded allowable depreciation for tax purposes, part of the cost of replacing the existing capital stock at current prices was taxed as profits, thus leading to a higher effective tax rate and to higher cost of investment. This effect was widely discussed in connection with the tax legislation passed last year. Most economists judge that it has been eliminated by the new depreciation provisions. Japanese producers were insultated from the latter effect because depreciation costs were indexed.

The period after 1973 tells a different story regarding productivity growth also. Labor productivity growth slowed down in both countries; the decline is much larger in Japan. In the U.S. multifactor productivity growth also slowed, while in Japan the growth rate increased; that is, overall efficiency in Japan grew more rapidly after 1973 than in the prior period--despite the energy shock. In the U.S. energy productivity and capital productivity declined. Part of these declines may be traceable to the fact that the U.S. data end in 1977, so that recovery from the recession may be incomplete. Further, some have argued that environmental regulations may have contributed, in that air pollution control equipment is energy intensive in its operation. Whatever the source of the problem, energy productivity did not improve in U.S. manufacturing in the first four years after 1973.

In Japan, the rate of energy productivity growth doubled after 1973. This result is not surprising--Japan relies for most of its energy on imports, and its domestic price is higher than in the U.S. We would therefore expect Japan to have had a stronger incentive to develop energy-saving technology before 1973 than the U.S., where domestic supplies have been relatively abundant.

In both the U.S. and Japan, materials productivity growth after 1973 is almost unchanged from the prior period.

As Table 3 shows, the growth rate of labor input in the two countries after 1973 shows two quite different patterns: while labor input in the U.S. grew somewhat, it declined in Japan at about 2 1/2 percent per year. In fact, in this five year period, the labor force in Japanese manufacturing declined by more than 10 percent, while the productivity of those remaining workers grew by more than 5 percent per year. And this was accomplished in an economic environment of much slower growth in output than in the prior period.

These, then, are some of the elements of the "miracle" of Japanese productivity: very high rates of labor productivity growth accompanied with very rapid growth in output and capital input before 1973, and rapid although

Table 3. Growth of Gross Output and Input Factors in U.S. and Japanese Manufacturing
Average Annual Rates of Growth

Years	Gross Output		Capital		Labor		Energy		Materials	
	U.S.	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan
1965-73	3.70	12.46	4.19	16.54	1.25	1.37	3.64	10.96	3.82	11.43
1973-78	1.08	2.85	3.06	3.00	-0.75	-2.57	1.79	-0.42	1.08	1.70

Source: Unofficial research results from J. R. Norsworthy and David H. Malmquist, "Input Measurement in Japanese and U.S. Manufacturing."

diminished labor productivity growth after 1973 even in the face of much lower output growth and capital formation.

III. Some Sources of Productivity Growth in the U.S. and Japan

What is the source of this productivity miracle? By exploiting the framework provided by multifactor productivity analysis, we can quantify some of the factors that have contributed to productivity growth in both countries. This approach permits us to gauge the effects of changes in the intensity of other inputs relative to labor, and changes in overall efficiency on the growth in labor productivity.[4] Using this "relative intensity" approach, we can measure a kind of substitution or supplementation effect in the growth of labor productivity that does not depend on an elaborate econometric model. In a more limited framework, the capital-labor ratio is often used to measure the change in capital intensity relative to labor. Our analysis includes the effect of the capital-labor ratio and also considers the energy-labor and materials-labor ratio in the same way.

The results are shown in Table 4. Here we observe the effects on labor productivity of growth in capital, energy and materials, and growth in overall efficiency--multifactor productivity--in the U.S. and Japan.

One impression from Table 4. is immediate: growth in other inputs relative to labor outweighs growth in overall efficiency as a contributor to labor productivity growth in both countries.

Table 4. Sources of Labor Productivity Growth
In U.S., and Japanese Manufacturing
Based on Factor Intensities Relative to Labor

	Labor Productivity Growth	Capital Effect	Energy Effect	Materials Effect	Multifactor Productivity Effect (Overall Efficiency)
			U.S. Manufacturing		
1965-73	2.45	0.31	0.03	1.56	0.54
1973-77	1.83	0.26	0.05	1.19	0.33
			Japanese Manufacturing		
1965-73	11.08	3.91	0.24	6.14	0.79
1973-78	5.42	1.31	0.05	2.63	1.43

Source: Unofficial research results from J. R. Norsworthy and David H. Malmquist, "Input Measurement in Japanese and U.S. Manufacturing."

Also, the largest source of labor productivity growth in each country is growth of materials. However, this should not be mistaken as meaning that capital--or indeed labor, as I note below--is not in a structural sense critical to increasing labor's capacity to process an increasing flow of materials. Because materials inputs constitute such a large share of the total cost of production in each country, they play a large role in this type of analysis.[5] Comparing the two countries, it is clear that the more rapid growth of other inputs--capital, energy and materials--accounts for much of the difference between U.S. and Japanese rates of labor productivity growth. The difference in growth in overall efficiency--multifactor productivity growth--contributes about one percent per year in the post-1973 period to a difference of 3.6 percent per year in labor productivity growth. Before 1973, the growth in multifactor productivity was only about one fourth of one percent per year, when the difference in the rates of labor productivity growth was about eight and one half percent.

These results should go some distance to dispel the aura of mystery that surrounds some discussions of productivity growth in Japan. For in the main, we see that rapid growth in the capital stock, which can be viewed as raising the workers' capacity to process a greater volume of materials, is a major source of Japanese growth. And while this rapid growth in capital and materials inputs can be thought of as representing substantial technological change, the overall efficiency of Japanese manufacturing as measured by growth in the productivity of all inputs combined has not shown remarkable growth relative to that in the U.S.

What of the widely discussed dedication and motivation of the Japanese worker? The framework that we have used for analysis does not permit us to address that issue directly. However, if the source of the Japanese advantage in productivity improvement derived primarily from the higher quality of the Japanese worker, we might expect to see a greater increase in overall efficiency--in multifactor productivity growth--rather than a pattern that seems to rely on more conventional sources of growth: greater investment and greater throughput of materials.[6] Nevertheless, the role of labor relations in Japan should not be underestimated. In general, workers' willingness to accept and accommodate new technology is an important element in the cost of introducing new capital equipment and new working techniques.[7] So it may be that labor-management relations in Japan have played a major part in smoothing the assimilation of the new technology that has resulted in rapid labor productivity growth.

Another result of our research serves to illustrate the role of greater investment in Japan. In the value added portion of U.S. manufacturing--the portion attributable to capital and labor alone, excluding intermediate goods (energy and materials)--labor's share is about 75%, so that capital's share is 25%. In Japan, capital accounts for about two-thirds of value added, with labor compensation receiving one third. Roughly speaking, manufacturing wages in Japan are about half those in the U.S. Consequently, if wages in Japan were doubled to approximately the same level as U.S. wages, value added in Japan would be about evenly divided between labor and capital. In other words, every hour of Japanese labor would be supplemented by an equal expenditure on capital services, while in the U.S. every hour of labor is supplemented by capital services worth only one third as much. So even with the wage differences accounted for, the Japanese worker has much more capital services to work with, compared to the U.S. worker.

IV. Summary

In examining recent manufacturing productivity trends in the U.S. and other countries, we find that the slowdown in labor productivity growth after 1973 is quite general. Rising energy prices and slower output growth are widespread during this period.

In examining the U.S. experience compared with that of Japan in some detail, greater capital investment and greater processing of materials per worker have led to far greater labor productivity growth in Japan. Growth in the efficiency of all productive inputs combined--multifactor productivity growth including labor, captal, energy and materials--has not been much greater in Japan than in the U.S. The major difference attributes to growth in the capital and materials inputs used in conjunction with the Japanese labor force.

Footnotes

[1] These statistics are based on the GNP accounts of the countries listed. The measurement basis is somewhat different from that used in the detailed comparison between the U.S. and Japan below.

[2] See especially E. R. Berndt and D. O. Wood, "Technology, Prices and the Derived Demand for Energy", Review of Economics and Statistics, August, 1975.

[3] For example, see E. Hudson and D. W. Jorgenson, "Energy Prices and the U.S. Economy," Data Resources Review, Sept., 1978.

[4] This framework is an extension of that in our study of the sources of the productivity slowdown in major sectors of the U.S. economy: J. R. Norsworthy, Michael J. Harper and Kent Kunze, "The Slowdown in Productivity Growth: Analysis of Some Contributing Factors", Brookings Papers on Economic Activity, Fall, 1979.

[5] In particular, the effect of materials on labor productivity is computed as the growth rate in the materials-labor ratio, multiplied by materials' share in the cost of production. A 10% growth in the labor-materials ratio, multiplied by .6 yields a contribution of 6% to labor productivity growth. Similarly, the capital-labor and energy-labor ratios contribute. The sum of these factor-intensity contributions with overall efficiency growth exactly equals labor productivity growth.

[6] Dr. F. R. Lichtenberg of the National Bureau of Economic Research has found that worker "quality"--as measured by experience in the present job--is more strongly associated with multifactor productivity growth than with labor productivity alone. See F. R. Lichtenberg, "Training, Tenure and Productivity" unpublished Ph.D. dissertation, University of Pennsylvania, 1981.

[7] Craig Zabala of the Bureau of Labor Statistics argues in his dissertation that worker acceptance of new technology is a necessary part of realizing the cost savings that new capital is designed to achieve. Otherwise, worker resistance to new technology may raise costs. See Craig Zabala, "Collective Bargaining at UAW Local 645, General Motors Assembly Division, Van Nuys, California, 1976-1981," unpublished Ph.D. dissertation, UCLA, 1982.

Mr. **Baumol**. Mr. Chairman, we just demonstrated that real economists differ too much, not too little.

Senator **Quayle**. That is why I wanted to dismiss you before we get into the areas of disagreement.

From the Japan Productivity Council, Mr. Arai; and from Dana Corp., Mr. Cowie; and from the U.S. Chamber of Commerce, Mr. Utt and Mr. Volpe.

The committee will be in recess for 3 minutes.

[Short recess.]

Senator **Quayle**. Before we begin this panel, it is my privilege to welcome the distinguished Senator from Florida, Mrs. Hawkins, to the committee this morning, and I will yield to her this time. She happens to have an intense interest in productivity, and as a matter of fact, has recently traveled to Japan to find out some of the magic that we keep hearing about, and as a member of the American Productivity Committee, I turn to her for any comments.

Senator Hawkins.

Senator **Hawkins**. Thank you, Mr. Chairman.

I understand our time constraints, and I made a special effort to rearrange my schedule so I could attend your hearings, because it has such impact on America and its future.

Last year I was privileged to travel through Japan as a member of the American Productivity Committee that we were invited to join, and had a productivity tour of Japan, which is most illuminating, and I am delighted that Mr. Arai has been asked to testify before our subcommittee, because it gives me a chance to thank him once again for his courtesies and help that he extended during that trip.

I found that tour very educational, and it made a very strong impression on me about the changes that we need to make in our Government policies, in order to increase our productivity. That trip convinced me that American businesses can and must adopt some concepts that are used in Japan, if we are to improve our competitive position in the world marketplace.

While Japan is well known for its technology innovation, the Japanese feel that the U.S. businesses put too much emphasis on technology, and not enough on the labor management skills. I think you have seen that this year. We are making some improvements. We really will have to wait and see the results.

The Japanese stress facilitating personnel, people who can understand participatory skills, to teach managers to better use the expertise of workers, and I felt that their superiority in this area was demonstrated by their relationship between labor and management in Japan, where relations between labor and management in the United States are often confrontational, and antagonistic, and sometimes too late.

I found many Japanese businessmen gave their union leaders high credit for the economic growth. I traveled to Japan 4 years ago, on another visit with my husband, and was interested to find out that the number 50 that was on everybody's hat, on this particular plant that we toured, and on everybody's arms, the number 50, which I thought meant was their 50th anniversary, turned out to be that they were going to increase their productivity in that plant 50 percent that year. I was amazed by such a team spirit, that was printed on their hats and armbands, and everybody was pulling together, from the bottom to the top.

I know we come from a different background, I know our Americans like to be individuals, and do their own things, but I must say that I was most impressed with the team spirit, and I am looking forward to the distinguished panel witnesses that you have put together, and perhaps with some conversation we can find out the secrets, to improve this Nation's productivity, because it is obvious that we must all work together in this era of the world becoming smaller and smaller.

Thank you.

Senator QUAYLE. Well, thank you very much for that statement, and with that, no need to introduce the panel again.

Mr. Arai, will you please proceed?

STATEMENTS OF JOJI ARAI, MANAGER, JAPAN PRODUCTIVITY COUNCIL, WASHINGTON, D.C.; ROBERT COWIE, VICE PRESIDENT, PUBLIC AFFAIRS, DANA CORP., TOLEDO, OHIO; AND ROBERT UTT, ASSOCIATE CHIEF ECONOMIST FOR ECONOMIC POLICY, U.S. CHAMBER OF COMMERCE, ACCOMPANIED BY JOHN VOLPE, ASSOCIATE CHIEF ECONOMIST AND DIRECTOR, TRENDS AND PERSPECTIVE CENTER, A PANEL

Mr. ARAI. Thank you very much, Mr. Chairman, Senator Hawkins.

There is a prevailing impression among the American public that U.S. productivity fell behind that of Japan, creating a sense of crisis. However, the United States is still the leader in productivity performance among all the industrialized countries. If we were to compare, for instance, the levels of labor productivity, the manufacturing sector of the United States as of 1978—in 1970 price weight—showed 14.9 percent advantage over the Japanese and in the service sector an advantage of 55.6 percent.

Since there is a limitation on the availability of statistical information and each country uses a different accounting method and standard industrial classification code, it is an extremely difficult task to compare productivity performance on the international level. Our study of added value per man-hour in 1970 constant prices, based upon the available data, showed that as of 1976 only the steel industry and transportation equip-manufacturing in Japan had a relative advantage over their American counterparts. In the same study, comparable performance was noted in the electrical machinery industry. In all other industries and in the agricultural and service sectors, the U.S. performance was superior.

If we were to show, however, a relatively crude output performance per industrial comparison based upon 1977 U.S. Census of Manufacturing and MITI Industrial statistics, the United States had a clear advantage over Japan in food processing—60 percent—apparel—40 percent—precision instruments and petrochemicals, while Japan had advantages in steel—110 percent—general machinery—70 percent—transportation equipment and electrical machinery showing the obvious product competitiveness in the global market.

As for the productivity indices, in the past two decades, Japan maintained an 8-percent growth rate as compared to 2 percent for the United States and 4 percent for Germany. Although Japan registered a drastic decline in growth for the 3-year period starting in 1974, as a result of the oil embargo and subsequent worldwide recession, her recovery since 1978—9 percent—rather conspicuously contrasts with the performance of the United States and European countries—3 percent or below during the same period. Added value per employee of the manufacturing industry in Japan rose 71 percent between 1970 and 1978, while the U.S. counterparts registered 27.1 percent growth, Germany 39 percent, France 34 percent, and the United Kingdom 20 percent.

One of the primary contributing factors for productivity growth is the capital formation. Japan has been investing about 30 percent of her GNP in new plants and equipment in the last two decades while the United States has invested 17 percent, the United Kingdom 20 percent, and Germany 25 percent. The manufacturing sector normally invests 26 percent of its output as compared to 16 percent for the United States. A recent survey showed that more than 50 percent of investment went into automation and energy savings.

The result of high investment is particularly noticeable in the steel industry. There are 42 blast furnaces with inner volume larger than 2,000 cubic meters in Japan as compared to 7 in the United States. A little over 60 percent of the machinery in the machine tool industry is less than 10 years old, while 30 percent of those in the United States are of the same age.

With a relatively high investment in new plants and equipment, which raises labor/equipment ratio, we find that capital productivity of Japan is much lower than the United States indicating that the American corporations utilize equipment more effectively than their counterparts.

There are many reasons why Japan's investment rate has been and is high. One notable factor is fierce competition in the domestic market. Despite heavy financial burdens, many corporations are forced to keep investing in more equipment to just stay in the marketplace. For instance, in the VLSI, manufacturing companies are spending large amounts in new plants for production of not only 64k chips, but also for possible production of 256k's and possibly 1 mega chips. They foresee that new plants will become obsolete in 4 years due to rapidly changing technology and have to retrieve 50 percent of their investment in the first year and the remainder in the second and third year. Only the fourth year will produce a profit, and that, too, must be plowed back for the production of more sophisticated products in order to survive.

The second factor is the accelerated depreciation available for investment in plants and equipment, purchase of pollution control and abatement equipment, numerically controlled and computer controlled machine tools, computers, industrial robots with intelligence and other equipment which qualify for a 13-percent writeoff.

The third factor is a big debt equity ratio. The average net worth of Japanese companies is about 20 percent, meaning that 80 percent of the needed capital has to be supplied by a financial institution. Unlike investors who want to reap a return on an investment in the shortest possible time, banks look toward a long-term commitment on their loans. This attitude of bankers enables management to make investment decisions based upon long-term strategic perspectives.

The fourth factor is the high savings rate of the public which enables banks to extend corporate loans for a relatively low interest rate. The current savings rate of the public is 21 percent of the disposable income, and the prime rate is 7.5 percent.

The fifth factor is a relatively high return on investment in automated equipment and robotic systems. While American management adhered to the traditional concept that investment in quality improvement adversely affected the profit picture, Japan discovered that effective use of electromechanical devices reduced the defect ratio, eliminating the investment on rework, wasted material and energies which, in turn, enabled them to increase their market share and apply the experience curve for further reduction of the costs. When American and European management opted to produce products abroad or to utilize guest workers to cope with labor shortages and the rising domestic labor costs, Japan decided to initiate an onslaught on automating the manufacturing process. The apparent high cost of automation at the outset soon turned out to be a profitable one as the meantime between failures was substantially lengthened, and machines showed high potential for not being susceptible to human errors.

The second category of the primary contributor to productivity improvement is the research and development effort. While the United States is still ahead of Japan in its efforts to create technological breakthroughs—2.1 percent of the GNP for the United States and 1.7 percent for Japan—there is a notable difference in approach between the two countries. While 60 percent of the total R. & D. fund comes from the Government in the United States, only 28 percent of the required fund comes from the public sector in Japan. Thus, the Japanese R. & D. can be termed as private sector oriented forcing business to devote a large percentage for development of new products. Thus, we see a number of American developed technologies being quickly translated into commercial products by Japan. As of 1979, Japan purchased 1.4 billion dollars' worth of technology from foreign countries while she sold only 400 million of her own technology.

This trend, as well as the number of American Nobel Prize winners and patents, gave rise to a popular concept that Japanese are not creative, which is a dangerous assumption. For instance, there are 26 scientists per 10,000 population in the United States as compared to 25 in Japan. Twenty-eight percent of the 500 largest corporations in Japan have CEO's with engineering background as against the United States 18 percent. This percentage increases to 52 percent if we are to examine the CEO's of manufacturing companies. Of 70,000 patents applied for in the United States, 10 percent come from Japan, representing the largest number being applied for by a foreign country. The optical fibre development can be cited by Japanese to counter the American argument that IC technology was copied by Japanese. I believe that technology will be the primary ingredient that will enable us to be competitive in the global market in competition with the developing countries, and at the same time contribute toward improving the standard of living of the world's entire population in the era of depleting natural resources.

As to the incentives that make Japan sensitive toward its need, there are the following external and internal factors:

The first is the recognition by businessmen that staying with the traditional technology will not enable them to compete with developing countries which have a labor cost advantage and ready access to technology and new equipment, just as they have been available to Japan. The businessmen know that they need their own technology to keep ahead of the developing countries and also enable them to enjoy a dominant position by monopolizing the market with a possible high return.

The second one is a tax incentive. Under the law, a business that keeps increasing R. & D. investment may write off 20 percent of the increment over the previous year. A sale of technology abroad enables business to write off 26 percent of the selling price, and consulting in foreign countries earns a 16-percent write-off.

The third and most important factor is a capability to change, particularly with respect to mentality. Until 1950, Japanese unions had a ideological orientation with the goal of establishing a proletarian society through class struggles. They frequently walked out on the job for the slightest provocation disrupting the economy and sometimes bankrupting companies. A public outcry for moderation and the exposure to the American labor movement resulted in an emergence of moderate leaders with views toward cooperating with companies for expanding the size of the pie to be shared with management, rather than struggling for an increased percentage share of the same size pie.

The second change occurred after 1974 when unions earned a 25-percent pay hike which was immediately followed by double-digit inflation. Recognizing the cause and effect of these demands for pay raises, they have moderated their demand in the last 5 years and always agreed to a settlement at a level comparable or below the productivity growth rate. The number of days lost to strikes declined from an annual average of 3 million man-days to 1 million. This is a notable achievement because Germany with one-half of the labor force now loses 1.5 million man-days even though they have the codetermination system. The United States, incidentally, loses 35 to 65 million man-days to strikes.

On the part of management, they have established new corporate goals:

One, a corporation exists for the people who work for it.

Two, a corporation exists for serving customers who buy its products and services.

Three, a corporation serves its shareholders.

The goals are similar to ones for American corporations except for the reversal of priorities.

Because a corporation serves its own people, discharging or laying off of employees due to a declining economy is out of the question. In a recession, the first consideration is shortening of work hours, diversification to downstream product lines. In return, employees develop a sense of sharing the destiny of the corporation with management. This sentiment of the employees can be shown by the number of suggestions a company receives from its employees. The average is 20 and the acceptance ratio by management is 85 percent, which favorably compares with the American average of 5 and acceptance of 10 percent.

Since there is a long-term commitment from both sides and the need to develop a strategy for growth and survival, Japanese companies usually spent from $50 to $150 per employee for training, retraining, and education of the work force. Even when the company introduces automated equipment and robots, management sets aside 3 months to 1 year for retraining of employees to be displaced so that they may acquire new skills to fill better paid and more interesting jobs. Typically in the automation process, employees are retrained to become sales and maintenance engineers and software specialists.

To accomplish the second goal, companies strive to deliver the highest quality products for the lowest cost. This philosophy resulted in the development of total quality control or corporate-wide quality control concepts and the creation of quality circles. The quality control concept itself changed from the inspection oriented quality control which is the prevalent American method to the process oriented Q.C. and further to new product development Q.C. with the view that if a corporation has a perfect production system and new products were designed to assure no defect, there ought to be no products susceptible to breakdown. The obvious reward is a customer satisfaction and increased market share.

I would not comment upon corporate obligation toward shareholders as it is the same as that of any American corporation, except to say that Japanese management is less influenced by shareholders as cross-ownership among affiliated companies and banks are prevalent in Japan.

The productivity program is nothing more than a learning process—learning the best of others and using the experience of others to your best advantage.

Japan has learned a great deal from the United States and will continue to do so. Our experience will be related to others so that they, too, may benefit. Perhaps the best lesson we derive from productivity is that through learning we will produce more of better quality using less precious natural resources and energy, and ultimately that will assure peace and prosperity to the world.

Thank you.

Senator QUAYLE. Thank you very much, Mr. Arai.

Mr. Cowie.

Mr. COWIE. Thank you, Senator. It is a pleasure to be here.

As you know, I am Robert Cowie, and I am the vice president, public affairs, for the Dana Corp., headquartered in Toledo, Ohio. I am pleased to respond to your request to testify before the Subcommittee on Employment and Productivity on the subject of productivity at Dana. It is a very special privilege to be here because the majority of our assets are concentrated in your home State of Indiana.

Senator QUAYLE. I am well aware of that. Thank you. We want more.

Mr. COWIE. Before I accepted my present assignment at Dana, I was a Dana operating manager for 20 years. Most recently, I was division manager responsible for the largest Dana facility then using the Scanlon plan, which I will describe later.

Let me say a word about Dana. We are an international manufacturer and distributor of power transmission equipment for the industrial and motor vehicle markets. We operate 89 manufacturing facilities in North America and a total of 180 manufacturing facilities around the world. Our sales in 1981 were $2.7 billion, and profits were $115 million. We employ 21,000 people in the United States and another 12,000 around the world. Our company has been continuously profitable for over 50 years and, until the recent downturn, had experienced a decade of uninterrupted growth, with sales increasing from $636 million to $2.7 billion.

My subject today is the productivity of Dana people and some of the ways they have achieved it. There is nothing mystical or mysterious about productivity. To the extent that Dana has been successful, it is the result of applying some very basic commonsense practices and attitudes intended to encourage what most people will do naturally if given the proper climate, opportunity, and incentives; namely be productive.

Productivity has been a concern at Dana for many years. We have tried many approaches and, to paraphrase a bit of oriental philosophy, we have found that there are many paths to the summit. There are many ways to achieve productivity, but all involve a common element, that is a high level of involvement and commitment by the total work force. Investment and technology are important ingredients in the productivity equation but, by themselves, they do nothing. Investment unutilized and technology unapplied will not increase productivity. They represent only potential. The essential ingredient in productivity has always been human. The people must use the tools. Using new tools or using old tools in new ways always involves change, so our job really is to foster change.

Two key activities are involved in most productivity programs, including those used at Dana: first, creating a climate and incentives for change and improvement and, second, creating the knowledge and tools necessary to increase production.

The knowledge and tools part of it is a big subject, and one which I will leave to others. I would like to concentrate today on creating the climate for change and productivity.

The first element is communication. Communication is like taking vitamins; it may be possible to overdo it, but most problems result from too little, not too much.

The real key to good communications is to tell the people what they want to know; namely, and roughly in order of importance, "How am I doing and what are my prospects?"; and "How is our company doing and what are its prospects?" They want to know how the place works, what the opportunities are, and what they need to worry about. And then you must listen. Without a dialog, there is no communication.

We have lots of ways of communicating, but some are crucial. We try to fit the medium to the message. Let me give some examples.

Gerry Mitchell, our chairman, and Stan Gustafson, our president, are continuing a long tradition of Dana management by personally visiting our plants to meet and talk with Dana people. During the last year, they personally made over 44 plant visits. This is a major commitment of their time, and their willingness to make this commitment is evidence of the importance they place on this form of communication. During a visit they will meet individually with all of the people if humanly possible, perhaps up to 2,000 in one location. Then they have a big meeting, with everyone invited. After a short talk, the people at that location have an opportunity to ask questions and they do so. They leave behind a poster and some self-addressed mailers to encourage the people to write in with additional questions. The objective is to stimulate a dialog.

Plant managers, superintendents, and foremen all meet with their people regularly. Plant managers will meet with the whole plant, not an easy task when plants number up to 2,000. During these meetings, management reports the facts as they are. They report the good news as well as the bad. They share the results of a particular plant's operations with the people so they know what the sales, profits, and production forecasts are. Some may think it is poor practice to disclose profits to the people, particularly if profits are good. But, if we did not share this information, the people would make it up for themselves, and what they would then believe would generally be wilder than our wildest dreams. I am sure you are familiar with the surveys that show that the public thinks that company profits average anywhere from 25 to 50 cents on the dollar where, in truth, most companies do very well to keep 5 or 6 cents on the dollar and the average for U.S. industrial companies is 4.7 cents.

During these meetings we encourage questions. There must be a dialog. It is not easy to answer these tough questions in front of a large group. One reason Gerry and Stan do it is to set an example for plant and division managers and to give the process credibility. But once a manager becomes accustomed to the process, they are very satisfied with the results.

We have a saying at Dana that the only dumb question is the one you do not ask. The great thing about these plant meetings is the really high quality of the questions that come from the people. They are often well informed, and have a good understanding of their situation, and they always display a high level of interest.

In addition to these meetings, Gerry Mitchell writes a letter to every employee about four times a year which is sent directly to their home. In these letters he discusses the issues facing the company, our market conditions, and his personal view of our overall situation. We also have a newsletter which is mailed on the seventh working day of each month, which reports corporate financial results for the previous month, and deals with the latest news from around the company. We try to deal with the hot issues, the rumors, and what is on the grapevine, and leave out the picnics and the promotions, which they can learn about some other way. That keeps our readership high. Frank communication always carries with it some risk, but we accept the risk because we think real communication is so important.

We provide a toll-free telephone line anywhere in the United States, Canada, the Virgin Islands, and the United Kingdom where anyone can call to get the latest corporate operating results and leave a question. Last year we received 10,000 calls. As far as I know, Dana is the only publicly held industrial company that reports its results monthly. It is all part of keeping the people informed and getting the broadest possible understanding.

To support this communications effort, we try to simplify our reports as much as possible. We believe our results should be interpretable without benefit of an accounting degree. Our annual report is a good example of this. I have enclosed a copy of our annual report with a copy of the submission so you can see for yourself.

[NOTE.—In the interest of economy, the material referred to was retained in the files of the committee.]

Mr. COWIE. All the necessary information is there, but we try hard to make it intelligible to someone without formal training.

When we do our communications job well, we develop credibility throughout our organization. The people believe what they hear.

Credibility is an essential forerunner to the next step in building a climate, which is involvement.

Involvement means that the people in the organization share a set of common goals. They believe that what is good for the organization as a whole is good for them. They believe that the threat to them is from the outside, their competitor, not from inside the organization. If they believe this and internalize it and act on it, a good share of the battle to create the climate for change is won.

To develop a sense of common goals, organizational barriers must be broken. We must break down the barriers that divide departments, plants, and divisions that grow due to misplaced organizational pride and jealousies. Perhaps more important, we must break the barriers that divide levels in the old-fashioned, pyramid style organization.

One way to break down these barriers is to develop wide stock ownership among our people. Over 70 percent of all Dana U.S. employees own Dana stock. Last year they put in $16 million of their own money to buy it. During a serious downturn in business with a 30-percent reduction in force, they increased their total contributions to the stock plan by 20 percent. Dana people now own over 10 percent of the company.

In many of our plants everyone is on salary. There is no distinction between management and hourly people. Most of our plants have no timeclocks, no bells or whistles to tell the people when to work and when to stop.

Another way to eliminate barriers is to have fewer layers of management. We have developed a streamlined organization with just five levels between the chairman and the shop floor. This keeps management from becoming remote and it is also an important means of achieving productivity. We have fewer managers and they are spread thin so people must manage themselves. This is the most demanding but the best kind of management. In one plant of 81 people, we have only 2 supervisors, including the plant manager. The people plan their own work and manage themselves.

Style is important. Style is hard to define, but basically it is the combination of formal and informal organizations, practices and traditions that together determine how things get done. At Dana, we have worked hard to develop a recognizable style that promotes productivity throughout the organization. It is described in a small booklet available to everyone. The subtitle of the book is "Working hard to keep it simple."

We try to use as little paper as possible, so we write few memos and prefer to rely on face-to-face communication where possible.

We have eliminated corporate procedures. We once had three volumes of detailed corporate procedures, but we threw them out and reduced it to a single page. Now, if a plant or division needs procedures, they create their own to meet their own needs. They do not get them from the corporation.

Dana Corp. develops our overall corporate strategies, and plans and divisions are responsible for carrying them out. But, beyond this, they are on their own. They make their own forecasts and commitments to Dana. We do not tell them what to produce or how much. It is their responsibility. We help them with capital if they have shown they can do the job, but we do not do their job for them. They know what they need to do to be competitive, and each division must do it for themselves. The responsibility for the survival and prosperity is at the local level. Decisions are made at the lowest possible level, often down on the shop floor. The people set their goals and make their commitments.

The real expert on any job is the person performing it. Another one of our "folk sayings" is that within the 25 square feet where they work, that person knows more about the job than anyone else. The key is to get them to work smarter—to get the benefit of their brain power as well as their brawn—to encourage them to think about the job—and to suggest ways to do it better.

One of the principal means we have used at Dana to involve people is called the Scanlon plan, and I would like to tell you a little about it.

We use the Scanlon plan in some form in 22 plants in North America, roughly one-third of our major facilities. About 5,000 people are involved. It is used wherever the people want to use it. They decide. Our general rule is that they should not use it unless three out of four people at the facility want it.

Basically, the Scanlon plan has two facets: a network of production committees to involve everyone in productivity improvement and a means to calculate and distribute the rewards flowing from that improvement. First, let me talk about the committee organization. Each department has a production committee, usually three or four people, with the supervisor normally serving as chairman. The role of this committee is to solicit and evaluate suggestions from the department. The committee has authority to put good suggestions which cost little, say $500, into use immediately without seeking further permission. They just do it. Worthy suggestions which cost more to implement than this threshold are forwarded to the screening committee, which includes representatives of all production committees, appropriate plant staff, and the plant manager. Suggestions considered at this level are ultimately either accepted or rejected. Regardless of the outcome, the individual who made the suggestion is informed of the decision. It is critical to the success of the program that every suggestion be considered and the decision made known to the submitter.

The response of the people is excellent and the quality of the suggestions is very high. On the average, about 75 percent of the suggestions made are accepted and utilized.

The second facet of the Scanlon plan is the reward system which reinforces the committee and suggestion system. The normal means of computing this bonus is to first determine, usually through historical data, a ratio between plant output and total payroll cost. Plant output is usually measured by sales, but this can be adjusted for inventory where appropriate. Plant payroll means total payroll because the plan includes everyone at a facility from the plant manager to the sweeper. It is another way of breaking the barriers and telling everyone we are all on the same team.

Once this base ratio is determined, it is used to calculate an allowable payroll each month based on the plant output for that month. If the actual payroll is less than the allowed payroll, three-fourths of the difference is distributed to the people and one-fourth is retained for future investment in capital equipment. The total bonus is distributed in proportion to the individual's percentage of the total plant payroll. Everyone gets the same percentage bonus at the end of the month.

Typical bonuses for a plan which has been operating for more than a break-in period average to 15 percent with the range being from zero to 30 percent.

In describing the Scanlon plan, I have, for the sake of brevity, swept away much of the detail which is well covered by the available literature. I will be glad to answer specific questions or provide more information. The important thing is that the plan be simple and well understood by everyone. It has to be credible, and to be credible it cannot be too sophisticated.

The fundamental thing to remember is that the people are involved, that they have a potential financial reward for their involvement, and they really like the involvement. In fact, the involvement is more important than the bonus. We have had plants run for over a year where no bonus has been paid because of a low level of operation, and the people have voted 93 percent in favor of continuing the plan at the end of the year.

Another important element in the climate for productivity is to provide the opportunity for personal growth. At Dana we promote exclusively from within. Dana people start at the entry level. This means that Dana people know that promotional opportunities which come from company growth will be available to them, based on their performance and their contribution to the company. They do not worry about somebody from the outside coming in to take a newly created job.

To grow people, we encourage them to expand their capabilities. Education is very important to us. We run our own Dana University. Last year, over 2,500 Dana people participated in these programs. In addition, thousands more participated in programs given at the plant levels. Personal growth opportunities help us to have better, more enthusiastic, and more effective people with a stronger sense of identity with our company.

We rotate people through jobs a great deal. In a recent 3-year period, for example, 80 percent of our controllers, sales managers, and plant managers took on new assignments. This does two things: First, it achieves a high level of cross-training. People understand each other's jobs and problems. Second, and perhaps more important, it builds a people network within the company. They know people in other plants and divisions. They know whom to call for help. We have woven a gigantic human communications network based on personal knowledge and experience. It works.

We measure productivity in a variety of ways, any way that is appropriate at the plant level. But we always measure overall productivity, including all the people at a facility. It is very easy to make a productivity gain on the shop floor and lose it in the office.

In addition, we have an overall measure of productivity for the corporation. We take our total sales, adjust for inflation, and divide by the number of employees. Measured this way, our productivity has doubled over the last 10 years.

We believe this result stems largely from our dedication to involving all our people in the management of the company.

I am not an expert in productivity. I have simply tried to describe some things that Dana has done to involve Dana people and create the climate which leads to productivity gains and which seem to have had good results. As I said at the outset, and I think you must now agree, there is nothing mysterious about the process—it is simply good communication, involving all of the people from top to bottom, and sharing the rewards. This is just another way of saying "good management."

I am convinced that our country will solve its productivity problems by discovering and utilizing the enormous human resources that are already available to us. Americans can and will compete with anyone in the world, but it is clear we have a job ahead of us.

Notwithstanding the many contributions the Japanese have made to this area of management, we are not Japanese and we need not become Japanese to meet this challenge.

We are American, we will do it the American way, and we will be successful.

Thank you.

Senator **Quayle**. Thank you very much, and we have been successful.

Mr. Utt.

Mr. **Utt**. Thank you, Mr. Chairman, Senator Hawkins.

On behalf of over 230,000 members, we welcome this opportunity to present the U.S. Chamber's general views on America's recent productivity experience and to provide the subcommittee with an overview of our current efforts in related areas, namely our productivity mission to Japan and our work in the area of skilled labor shortages.

In reviewing the literature on the productivity experience in this country and the many excellent presentations by the witnesses before this committee, it is apparent that the causes of our productivity decline are many and complex. And rather than rediscuss them at this point, I will focus my remarks on what the chamber believes are the appropriate public policy solutions to reversing that decline. In order to do this, I think it is important that we divide the causes of decline into two groups—one group where the problems are amenable to public policy actions, and the other group which consists of factors that are unique to the economy and are not amenable to public policy solutions.

In the area of public policy solutions, there are more basic problems that have confronted our country over the decade of the 1970's. They include, No. 1, the tax system which, because of accelerating inflation, became increasingly hostile to income from capital.

No. 2, excessive regulation which has drawn capital away from productive uses, has led to suboptimal production processes, and has discouraged new plant investment.

No. 3, frequent changes in economic policy disection that have contributed to wide fluctuations of business activity. As a consequence of frequent and intense economic cycles, business firms are discouraged from using capital intensive techniques. They rely increasingly on labor, whose costs can be reduced during downtime.

And, finally, the fourth contributing public policy factor are those policies that led to accelerating inflation which distorted economic decisionmaking and made future planning difficult.

Chief among the factors that are not amenable to public policy solutions are demographic changes which have led to an increase in the number of new entrants in the labor force; consumer buying preferences which have induced a shift of output toward services—possible changes in worker and management attitudes and a rise in energy prices.

In looking at the recent statistical analysis of our productivity decline, I find that, regardless of the model used, the data series, or the concepts used in constructing the study, most of these studies find that the two major factors contributing to our decline in productivity growth were the declining rate of capital formation and the substantial increase in energy prices.

High energy prices, by and large, are not easily curable through public policy solutions. However, with respect to our declining rate of capital formation, there are a wide variety of steps that can be taken to enhance this country's rate of investment.

Last summer, in recognition of our capital formation problem, the Congress enacted important legislation which, to a great extent, has eliminated many of the public policy impediments to capital formation, specifically, and productivity growth generally. To spur capital formation, we enacted the Economic Recovery Tax Act, which provides incentives for savings and investment. We reduced Government spending growth in an effort to shift resources from public to private uses, and have adopted, for the first time since 1976, an effective policy to moderate inflation. Unfortunately, many in Congress are now considering a substantial modification to this program. These modifications, we believe, will diminish the impact of the Economic Recovery Tax Act on capital formation and hence productivity.

In our view, such a policy reversal would be a grave mistake. It would jeopardize the recovery and diminish our productivity growth potential. The Economic Recovery Tax Act of 1981 is the foundation of the comprehensive set of policies to revitalize our economy and reverse the many years of economic stagnation and limited growth in our standard of living.

The Economic Recovery Tax Act was enacted in response to our widely acknowledged problems of low savings and investments, declining productivity growth, diminishing national competitiveness, and severe structural problems of some of our poor industries.

Today, these same concerns are even more pressing than they were 1 year ago, and the problem is now compounded by a recession that has spread faster and farther than any of us had anticipated a few short months ago. Under these circumstances, we believe it would be counterproductive to enact tax increases or delay the already enacted tax cuts. To do so would weaken the economy, create greater business uncertainty, and delay our meeting the productivity challenge.

That concludes my remarks and I will now turn the mike over to John Volpe, who will discuss our Japan productivity tour and the study of the skilled labor shortage.

Thank you.

[The prepared statement of Mr. Utt follows:]

STATEMENT
on
PRODUCTIVITY
before the
SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY
of the
SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES
for the
CHAMBER OF COMMERCE OF THE UNITED STATES
by
Dr. Ronald D. Utt and Dr. John Volpe
April 2, 1982

I am Ronald D. Utt, Associate Chief Economist for Economic Policy at the Chamber of Commerce of the United States. With me today is John Volpe, Associate Chief Economist for Research and Director of our Center on Trends and Perspective. On behalf of our over 230,000 members, we welcome this opportunity to present the U.S. Chamber's general views on America's recent productivity experience and to provide the Subcommittee with an overview of our current efforts in related areas, namely our productivity mission to Japan and our work in the area of skilled labor shortages.

SUMMARY

Beginning in 1968, the U.S. productivity growth rate began to decline. The decline worsened during the mid 1970's and turned negative during the last three years of the decade. While the causes of the decline are many and complex, it is evident that, by comparison with the years prior to 1968, a declining rate of capital investment, increased energy prices, and government regulation, stagnant research and development expenditures and numerous other factors were important contributors to the slower productivity growth.

While not all of these factors are amenable to public policy solutions, there are a number of steps that can be taken to help reverse this trend.

- The Economic Recovery Tax Act of 1981 will provide significant stimulus to increased capital formation and productivity growth over the remainder of the decade. The Chamber endorsed ERTA and would oppose any effort to diminish ERTA's impact by eliminating or substantially modifying its key provisions.

- Existing efforts to modify, reduce or eliminate burdensome regulations must be continued.
- Economic policies must be consistent over time and conducive to stable economic growth. Sharp changes in the direction of public policy create uncertainty and discourage businesses from making long-term investment commitments which boost productivity growth.
- The increase in energy costs since 1974 are now believed to have been an important contributing factor to our declining rate of productivity growth. Therefore, caution is urged in considering the enactment of oil import fees and fuel-related excise and additional windfall profits taxes since such increases could diminish our productivity growth potential.

The U.S. Chamber has long been involved in ways to improve America's productivity performance. Over the past several years, it has conducted two surveys of attitudes of top management and labor toward productivity, motivation and incentives. The findings were published in "Management Attitudes Toward Productivity" and "Worker's Attitudes Toward Productivity", both highly acclaimed and widely distributed booklets.

In addition, it has published "Productivity, People and Public Policy" which describes the U.S. postwar productivity performance and "Meeting the Productivity Challenge" which in part discusses policy options for improving U.S. productivity.

In February, the U.S. Chamber sponsored a tour of selected Japanese firms to review those factors that have contributed to that nation's enviable productivity growth record. It has also recently embarked on a survey of the skilled labor shortage problem, because of the relationship between skilled workers and productivity growth.

THE DECLINING RATE OF U.S. PRODUCTIVITY GROWTH

Since 1969, the rate of productivity growth in the United States has slowed appreciably. The deceleration of productivity growth, as Table 1 reveals, has been a two-stage process. In 1969-73, there occurred a small downturn by comparison with the 1948-68 time trend. This downturn increased substantially in 1974-81, culminating in three consecutive years of negative growth.

TABLE 1

PRODUCTIVITY GROWTH, ANNUAL PERCENT CHANGE

Private Business Sector

1948	3.8	1964	4.0
1949	1.6	1965	3.8
1950	7.9	1966	3.2
1951	2.8	1967	2.0
1952	2.8	1968	3.3
1953	3.1	1969	0.2
1954	1.6	1970	0.7
1955	4.0	1971	3.6
1956	1.3	1972	3.5
1957	2.8	1973	2.7
1958	2.5	1974	-2.3
1959	3.2	1975	2.3
1960	1.6	1976	3.3
1961	3.1	1977	2.1
1962	4.5	1978	-0.2
1963	3.8	1979	-0.3
		1980	-0.2
		1981	1.0

1948-1958: 3.1%
1959-1968: 3.3%
1969-1973: 2.1%
1974-1981: 0.7%

Source: Bureau of Labor Statistics.

To some degree, the negative growth rates witnessed during the latter part of the second period are related to cyclical factors. Productivity growth rates typically correlate with the business cycle, rising during periods of expansion and falling during recessions. Nevertheless, cyclical developments do not explain why productivity declined in absolute terms in 1978 and 1979 when the economy was expanding at a healthy rate of growth, nor do they account for the slowdown in productivity growth since 1969 and more acutely since 1974

1969-73: The Slowdown Begins During the 1969-73 period, productivity growth fell from an average of 3.2 percent to 2.1 percent. The capital-labor ratio began behaving in an uncharacteristic manner, registering unusually small increases in 1972 and 1973. Real capital stock growth for these years was moderately below the 4.5 percent average that prevailed from 1948 to 1968.

Spending on all types of research and development, as a percentage of GNP, fell from 2.83 percent in 1968 to 2.34 percent in 1973, while civilian R & D fell from 1.50 percent to 1.44 percent. This was less than the relative commitments of both West Germany and Japan.

The slowdown in this period was abetted by an accelerating inflation that coincided with overly expansive monetary policies, Great Society spending and growing Viet Nam war involvement. In addition, the first surge of World War II "babies" entered the labor force, often as unskilled workers needing considerable training. The significant negative impacts of expanding government regulation were also felt during this period.

The most conspicuous declines in productivity growth during the 1969-73 period occurred in the non-farm, non-manufacturing business sector. Mining, construction activity and the combined category of finance, insurance and real estate all showed a noticeable slowing in productivity gains.

1974-81: The Slowdown Worsens The productivity slowdown that began in 1969 accelerated rapidly after 1973. Even excluding 1974, when the decline could be attributed to a deep recession, productivity growth averaged only 1.1 percent per year from 1975 through 1981 -- the worst record since the Great Depression. What was especially significant during this period was that the declines caused by recession periods were not followed by substantial and sustained increases during the recovery periods, as might have been expected from historical experience. Negative values were reported from 1978 through most of 1981.

Growth in the real net capital stock declined severely during this period. Analysts can remember no other time when the stimulus to economic recovery produced such a weak response in capital investment. The increase in the capital-labor ratio also slowed considerably during this period. The average increase during the 1970's was 1.74 percent, only 50 percent of the average gain of 3.4 percent during the period 1948-58. Indeed, it actually declined for four consecutive years, beginning in 1976. Over the 1970's the United States dropped from first to sixth in terms of capital per worker.

Other measures were also indicating problems in the area of productivity performance over the 1974-81 period. Reflecting the slowdown in capital investment growth, the average age of business structures and equipment stopped declining about 1973-74. Between 1945 and 1973, the average age of structures fell continuously from 21.64 to 13.38 years. The average age of equipment dropped steadily from 10.18 years in 1935 to 6.30 years in 1951. It rose slightly over the 1950's and early 1960's, and declined again to 6.29 years in 1974. At that point, the trend toward modernization came to a halt -- and, for the first time since the Great Depression, the age of both structures and equipment began to increase.

During the 1970's, growth of expenditures for R & D also slowed in comparison to growth in GNP. Total defense and civilian R & D spending peaked in 1964 and has declined almost continuously since then. However, most of the decline has been in defense and space programs. Of more importance is total civilian R & D -- for it represents the effort to develop new products and technology that affect our economic well-being. Civilian R & D expanded as a percentage of GNP during the 1960's to 1.51 percent in 1969. But then it leveled off, and remained virtually on a plateau through the decade of the 1970's. Other countries already had surpassed the U.S. effort in civilian R & D by the early 1960's. West Germany and Japan increased their R & D commitments as a percent of GNP during the 1970's, thereby expanding their relative advantage over us.

Importantly, there is a growing body of evidence that indicates that the sharp increases in energy prices, first in 1974 and then in 1978, may have had a profound effect on our capital formation and productivity experience during the decade.

U.S. PRODUCTIVITY EXPERIENCE COMPARED TO OTHER INDUSTRIAL NATIONS

As an economy in which a highly skilled labor force and high wage rates prevail, and in a world where new technologies and their commercial applications quickly diffuse to other economies, an increasing number of which also have highly trained labor and many of which pay substantially lower wages, the United States must continually innovate in order to remain competitive in world markets. Thus, for the United States, the size, scope and direction of its R & D expenditures and how its efforts compare with those of its main trading partners should be very important to policymakers.

Although the United States is still the most productive nation in the world, recent comparative productivity growth trends indicate that our position of preeminence may be in jeopardy if relative growth differences persist. Table 2 below provides the details on these international trends for broad periods of time.

Table 2

REAL DOMESTIC PRODUCT PER EMPLOYED PERSON

Country	Relative Productivity[1]	Average Annual % Change in Productivity[2]		
	1980	1950-1968	1969-1973	1974-1980
Japan	68.4	7.7	8.4	3.5
West Germany	88.7	5.4	4.5	2.9
Italy	60.6	5.8	5.1	1.8
France	89.4	4.6	4.9	2.6
Canada	92.1	2.6	2.7	0.0
United Kingdom	60.8	2.4	3.2	1.3
United States	100.0	2.3	1.6	0.3

1/ Real gross domestic product per employed person using international price weights.

2/ Growth in real domestic product per employed person using our country's price weights.

Source: Bureau of Labor Statistics

Although productivity growth in the United States has largely trailed that of the other major industrial countries during the postwar era, note that the decline beginning in 1974 occurred in each of the listed countries. However, relative to past trends, the U.S. decline was worse than that experienced by others, with the exception of Canada.

Table 3 indicates that the above noted trends generally held for the manufacturing sector as well.

Table 3

MANUFACTURING PRODUCTIVITY, ANNUAL RATES OF CHANGE IN OUTPUT PER HOUR

Country	1973-80	1978-79	1979-80
United States	1.7%	1.0%	-0.5
Canada	2.2	1.2	-1.4
Japan	7.2	8.1	6.2
France	4.9	4.7	3.3
Germany	4.8	6.3	-0.7
Italy	3.5	9.0	2.9
United Kingdom	1.4	2.5	-1.3

Source: Bureau of Labor Statistics

Note, however, that while the relative rankings of 1973-80 held up for 1979, 1980 showed wide divergence in productivity growth from past trends for some countries. It is not at all clear whether this represents the beginning of a new trend reflecting fundamental changes or whether it relates to cyclical factors caused by the economic downturn that has afflicted many of the world's economies beginning in 1979-1980.

CAUSES OF THE U.S. PRODUCTIVITY GROWTH DECLINE

Beginning in the early 1970's, a number of economists and public policy-makers began turning their attention to the determinants of productivity growth in an effort to better understand the sources of economic growth and to develop public policies conducive to a rapidly rising standard of living. Initially, the findings were not promising. Since productivity was viewed as being influenced by many factors, the earlier statistical studies were unable to determine which factors, some being difficult to measure and quantify, had the predominant influence. It was not until the end of the last decade and the beginning of this one that improvements in our statistical techniques, better data specification and a greater understanding of the issue led to the completion of studies that provided a clearer perception of the causes of the problem.

Although the number of important influences has been narrowed significantly, there is still disagreement between studies as to the relative importance of each. As more analytical work in this area is completed, our understanding of the productivity problem should improve. Nonetheless, the work that has been completed to date offers some useful insights into the problem as well as some guidelines for the appropriate direction of economic policy.

The Decline in the Rate of Capital Formation On both an anecdotal and theoretical basis, most students of our productivity decline ascribe it to a decline in our rate of capital formation. Unfortunately, the proof of this proposition, however logical, remained elusive, as early statistical studies generally failed to show a strong link between capital formation and changes in productivity growth. The measurement problem, in retrospect, was largely due to an inappropriate specification of the capital input. On the surface, the statistics on investment generally indicate that our capital formation experience has not been inadequate relative to past trends. Indeed, as Table 4 shows, it appears to have improved.

Table 4

SHARE OF NON-RESIDENTIAL FIXED INVESTMENT IN GROSS NATIONAL PRODUCT

Period	Investment as % of GNP
1960-65	9.6
1966-70	10.6
1971-81	10.8
1971	10.5
1972	10.0
1973	10.8
1974	10.9
1975	10.2
1976	10.2
1977	10.7
1978	11.2
1979	11.6
1980	11.3
1981	11.2

Source: U.S. Department of Commerce

However, when expressed on a net basis by adjusting for depreciation that reflects the changing mix between structures (which depreciate slowly) and equipment (which depreciate quickly), a different picture emerges. Table 5 illustrates the relative decline that has occurred in both net private investment and net fixed, non-residential investment.

Table 5

Net Investment as a Share of Gross National Product

Period	Net Private Investment	Net Fixed, Non-Residential Investment
1960-65	.080	.027
1966-70	.071	.040
1971-80	.059	.029
1971	.066	.029
1972	.075	.031
1973	.085	.040
1974	.064	.035
1975	.028	.019
1976	.046	.020
1977	.061	.026
1978	.066	.031
1979	.061	.033
1980	.040	.027

Source: National Bureau of Economic Research

Expressed on a net basis, Table 6 illustrates the declining rate of growth in capital formation. As can be seen from the summary periods at the bottom, the rate of net investment declined during the 1970's.

Table 6

GROWTH RATE OF THE REAL NET CAPITAL STOCK:
1948-1979

Year	Growth Rate	Year	Growth Rate
1948	8.0	1966	6.7
1949	4.7	1967	5.4
1950	5.0	1968	5.1
1951	5.0	1969	5.4
1952	3.9	1970	4.2
1953	4.3	1971	3.3
1954	3.4	1972	3.9
1955	4.3	1973	5.2
1956	4.5	1974	4.3
1957	4.1	1975	2.1
1958	2.3	1976	2.2
1959	2.8	1977	3.1
1960	3.2	1978	3.7
1961	2.8	1979	4.0
1962	3.5	1948-1958	4.5
1963	3.5	1959-1969	4.4
1964	4.4	1970-1979	3.6
1965	6.0		

(Net Stock of Fixed Nonresidential Private Capital in 1972 Dollars)

Source: U.S. Department of Commerce

Measuring the rate of investment, regardless of its form, independent of the other factors of production leads to only a partial description of our capital formation problem. Specifically, capital should be compared with the employed workforce to construct a better measure of capital adequacy and intensity. A rapidly rising capital-labor ratio indicates that the production process is becoming more capital intensive and, all things equal, that the workforce is becoming more productive as new technologies and greater degrees of automation are applied to the production of goods and services.

When the ratio declines, the converse holds. Table 7 details the changes in the U.S. capital-labor ratio over the postwar era. As the table demonstrates, the trend has been downward and that our most recent rates of growth have been only half that of the 1948-1958 period. From 1976 to 1979, the rate of growth actually turned negative, coinciding with the actual declines in our productivity growth rate.

Table 7

THE CAPITAL-LABOR RATIO AND ITS RATE OF CHANGE: 1947-1981

Year	Ratio	Rate of Change	Year	Ratio	Rate of Change
1947	0.45931		1964	0.73522	2.43%
1948	0.48226	5.00%	1965	0.74757	1.68
1949	0.50755	5.24	1966	0.76747	2.66
1950	0.52524	3.49	1967	0.79944	4.17
1951	0.53374	1.48	1968	0.81908	2.46
1952	0.54178	2.65	1969	0.83578	2.04
1953	0.55574	1.56	1970	0.88233	5.57
1954	0.58805	5.81	1971	0.92014	4.28
1955	0.58586	-0.37	1972	0.92288	0.30
1956	0.59643	1.81	1973	0.92886	.65
1957	0.62252	4.37	1974	0.95964	3.31
1958	0.66413	6.67	1975	1.02524	6.84
1959	0.65389	-1.54	1976	1.01353	-1.14
1960	0.67022	2.50	1977	1.00000	-1.34
1961	0.69403	3.56	1978	0.98261	-1.74
1962	0.70183	1.12	1979	0.98211	-0.05
1963	0.71775	2.27	1980	1.01142	2.98
			1981	1.02845	1.68

1948-1958: 3.41%
1959-1968: 2.11%
1969-1981: 1.74%

Source: Bureau of Labor Statistics

While it is clear that our rate of capital formation has declined relative to past trends and that this has been an important contributing factor to our sharply reduced rate of productivity growth, the reasons for this are many and complex, and relate to a number of factors that occurred during the 1970's. Chief among them was a tax system that became increasingly hostile to income from capital. As inflation accelerated, inadequate depreciation allowances and an overstatement of net income resulting from illusory inventory profits led to excessive corporate income taxes. During much of the decade, the effective corporate income tax rate exceeded 50 percent. Moreover, high marginal personal income tax rates discouraged personal savings and traditional forms of financial investment, thus depriving the economy of the funds needed to finance increased capital investment.

Fortunately, this situation has been reversed by the passage of the Economic Recovery Tax Act (ERTA) in 1981. The Chamber endorsed the tax reductions embodied in that Act, believing that it will lead to a substantial increase in capital formation once financial market stability is restored. Given this view, we are very much opposed to the various proposals now being considered by Congress that would eliminate or modify some of the components of ERTA. Specifically, the proposals to eliminate safe-harbor leasing and enact a minimum corporate tax would greatly diminish the impact of ERTA on future rates of capital formation. This, in turn, would limit future productivity growth.

Beyond the past problems associated with our tax system, other factors that have contributed to our low rate of capital formation include an increase in capital costs relative to labor's, frequent bouts of economic instability, rising inflation and interest rates, excessive regulation and, importantly, a sharp rise in energy costs.

Increased Energy Costs First in 1974 and then again in 1978, the world economy was buffeted by sharp increases in the price of oil and other forms of energy. Since capital intensive forms of production have, in the past, been energy intensive forms of production, the increase in the price of energy encouraged businesses to seek alternative forms of production that economized on costly energy inputs. This change led to a reduction in the output of existing labor and capital resources, and, thus, the productive capacity of the economy.

As energy prices increased, business firms altered production methods to reduce the use of energy. Often, this implied production techniques that were less capital intensive. Many factories were rendered permanently obsolete and were closed, while others were operated at a reduced level. Further, existing labor and capital were diverted away from the production of goods and services to endeavors that enabled firms to economize on the high cost energy inputs. This led to a reduced output from a given level of capital and labor. In turn, measures of productivity such as output per hour, output per worker or output per unit of capital declined. However, our rate of "energy productivity" increased dramatically as less energy was needed to produce a given level of goods and services.

Although we have limited control over the price of energy inputs, there are a number of potentially important policy implications associated with the relationship between energy costs and productivity growth. Specifically, we would urge caution when considering oil import fees and fuel-related excise and additional windfall profits taxes as measures to either raise revenues and/or encourage conservation. Conservation is important in an era of unreliable suppliers. But when carried to the extreme, it can contribute to diminished economic growth and a lower standard of living. Similarly, tax increases to lower the deficit could have the same counterproductive effects.

Other Factors Influencing Productivity While recent studies indicate that depressed rates of capital formation and high energy costs have had an important effect in reducing our productivity growth rate since the early 1970's, analysts have identified other contributing factors as being of some degree of importance to our productivity experience. These include: demographic changes that have led to an increase in the number of new, unskilled workers in the labor force; increased government regulations (eg, OSHA, Clean Air, Clean Water), that have induced significant changes in the production process for many goods and services; less commitment to the work ethic; poor management practices; a shortage of workers and professionals with technological skills; and stagnant R & D spending.

INDUSTRIAL STUDY MISSION TO JAPAN

Tables 2 and 3 showed that Japan's productivity growth over the postwar period has been very impressive. Indeed, productivity gains in Japan, by any measure, have been significantly greater than those experienced by other nations in the industrializied world. Because of Japan's impressive productivity record, the U.S. Chamber, with the assistance of the Japan Productivity Center, in February of this year, sponsored a two-week industrial study mission to Japan. The purpose of the mission was to study human resource management techniques, analyze the impact these techniques have on Japan's productivity growth, and determine the extent to which these techniques can be instituted or utilized more intensively in the United States.

The group consisted of 13 American businessmen from such corporations as Xerox, Eaton, Carrier, Republic Steel, TRW, and The Williams Companies. It was lead by Harold Short, chairman of the board and chief executive officer of the Flatiron Companies and a former member of the Chamber's board of directors. Robert Thompson Jr., partner, Thompson, Mann & Hutson, and several other attorneys specializing in the labor and personnel field, were also in the group.

The group met with a large and diverse collection of Japanese businesses and labor institutions in Tokyo, Kyoto, and Osaka. Included in the list of host organizations were the Japanese Confederation of Labor (Domei), the Japanese Federation of Employer's Associations (Nikkerien), Ishikawajima-Harima Heavy Industries and its worker's union, Nipon Steel Corporation, NCR Japan, The Fuji Bank, and McDonalds Company (Japan).

The major objectives of the meetings were to study Japan's business/management philosophy, its personnel management techniques, employee training, labor management relations, and quality of worklife programs. The group was primarily interested in fundamental management philosophy, compensation policy, policies and programs to cope with automation, the importance of pay scales, incentive programs to spur productivity, channels of labor/management relations, and quality control systems.

The conclusions arrived at are too numerous to mention in a brief report. However, our group did find the meetings both substantive and informative. Japan's management philosophy is based mainly on a bottom-up consensus-based decision-making system. The personnel departments of the corporations visited were equal in status with other departments such as engineering and finance. The employee training programs are structured and lengthy, and include multiple skill training, which minimizes the number of lay-offs during adverse economic conditions and eases the adjustment to automation. Also, Japanese management and workers at all levels appear committed to total quality control, including the testing of all products coming off the assembly line and a strong commitment to small group (quality circle) activities to enhance productivity growth.

Both Japanese management and labor place major emphasis on lifetime employment, seniority-based compensation and company unions as significant factors in Japan's past productivity success. With 20 to 30 percent of the total work force (mainly in large corporations) covered by lifetime employment and skilled in diverse tasks, there is presumably a tendency for workers in these corporations not to fear or impede the introduction of labor-saving devices. Workers know, further, that their wages will rise in tandem with their seniority in the company. Finally, since all Japanese workers belong to company unions until they reach the level of Section Manager, it is hard to differentiate the goals of the union from those of the company. Thus, in all its forms, labor/management strife is mitigated.

U.S. participants concluded that Japan's human resource management techniques and the emphasis on lifetime employment, seniority based wages, and company unions contributed significantly to the nation's enviable productivity record over recent decades. They also noted, however, that there was very little they had witnessed with respect to ways of enhancing worker productivity that was not already in use, in some cases quite intensively, in the United States. In addition, they felt that lower economic growth rates anticipated by the world community for the foreseeable future, and the rapidly rising high-technology manufacturing capabilities of the advanced developing countries such as Brazil, Taiwan and Mexico, coupled with a rededication on the part of American business and government to fostering competitive excellence, would increase the competition Japan faces in world markets. These developments will add to the difficulty Japan undoubtedly will face in funding those factors mentioned above which have contributed so heavily to productivity growth.

Finally, tours of corporate facilities revealed an extensive amount of new capital equipment which undoubtedly contributes, perhaps even more decisively, to Japan's productivity growth. As we have already noted, poor rates of capital formation in the United States over the past two decades have undoubtedly contributed significantly to America's poor productivity performance. Certainly, high effective rates of taxation on corporate domestic income impeded the capital formation process. In fact, while it may be difficult to draw firm conclusions due to the complexities involved in assessing tax burdens within and between countries, a study published several years ago concluded that the effective rate of taxation on corporate domestic income was significantly higher in the United States than it was among our leading industrialized competitors. Fortunately, elements of President Reagan's tax package will reduce this competitive disadvantage.

SKILLED LABOR SHORTAGE PROJECT

Finally, we noted previously that rising rates of capital per worker increase the productivity of America's work force, as the introduction of new technology and further automation are applied to the production of goods and services. Particularly since the advance of technology requires highly skilled labor, and since researchers have shown that U.S. comparative advantage rests, in part, upon labor skills and human capital, skilled labor shortages could have a serious adverse impact on U.S. productivity growth. With this in mind, the U.S. Chamber's Council on Trends and Perspective has undertaken a project to determine the nature and extent of the skilled labor shortage problem, and ways by which business, government and labor can alleviate the problem.

Mr. Volpe. I am John Volpe, associate chief economist of the U.S. Chamber for Research. This is one time that being last is not all that bad because what I have to say has not been discussed so far. But, in keeping with the theme of these proceedings, I will try to make my remarks as efficient as possible.

The chamber, as Dr. Utt has demonstrated, has long been interested in the question of productivity, its disappointing growth in the last decade, and in ways that we can improve upon America's productivity performance. Over the last several years, the chamber has published several monographs dealing with worker and management attitudes toward productivity. In addition, it produced a very successful monograph recently entitled "Productivity, People, and "Public Policy," which focused on the U.S. postwar productivity performance and ways to enhance America's productivity growth.

The chamber's Council on Trends and Perspective, which studies emergency economic issues of interest to the U.S. business community, has included productivity issues as one of its major themes. More specifically, the Council is undertaking a survey of the skilled labor shortage issue to determine the nature of the problem, the sectors of the economy most affected, and a business community response to help alleviate that problem. The Council is also looking at the relationship between education and work, because productivity performance deals with more than just the rate and level of capital formation. Declining productivity growth also relates significantly to the basic reading, writing, and computing skills people learn in the school systems.

Finally, the Council is studying the question of innovation. How can we increase the rate of industrial innovation in order to improve America's international competitiveness and its rate of economic growth. These are some of the issues the Council on Trends and Perspective has taken on. Over the course of the next 6 months or so, we hope to have enough research evidence to return to this subcommittee with more information on these longer term factors that impact heavily on productivity performance in the United States.

The main reason why I am here today is to report on a 2-week industrial study mission to Japan that the chamber undertook only this past February in conjunction with the Japan Productivity Center. A large group of American businessmen visited a wide variety of corporations and unions in services and in manufacturing to study Japan's human resource management techniques. Our general purpose was to determine what the Japanese do to motivate workers and what can we learn and incorporate into our own production processes?

Corporate and union leaders told our group of American businessmen that the keys to Japan's productivity success over the postwar decade can be found in lifetime employment, company-based unions, seniority-based wages and the advent of small group activities, the latter basically an American phenomenon which the Japanese have had significant success in utilizing.

In the area of small group activities, the American businessmen felt that there was not much that the Japanese were doing that the more successful of the American corporations were not also doing.

Corporations like Dana, Xerox, TRW, Williams, and many others had similar small group activities, groups of 3 to 10 workers who gather together to find ways to improve productivity on the shop floor or in the office. In some cases, our group found that the Japanese did a little better job in motivating their workers than we were. And in other cases, the reverse was true. However, it was the extensive utilization of cannibal equipment, our group of Americans felt, that undoubtedly contributed to Japan's strong productivity performance.

At the end of our mission, we concluded their lifetime employment, seniority-based wages, company unions, and small group activities had indeed contributed significantly to Japan's postwar productivity success. However, it would be a mistake for the American business community to totally incorporate these and other Japanese features into our own economy, in part because we came away with the impression from our meetings with both union and management people that some of these concepts are undergoing changes. Indeed, in some cases there may be profound change, so much so that it may be difficult down the road for Japan to show the kinds of productivity success in the eighties that it did in the seventies.

Members of the industrial study mission to Japan are preparing reports of their observations. When all are in-hand, we will be happy to share them with members of this subcommittee. The U.S. Chamber may be planning additional productivity missions in the foreseeable future, and we will inform this subcommittee as developments unfold.

Thank you.

Senator **Quayle**. Thank you very much, Mr. Volpe.

Mr. Arai, what is the prime rate in Japan now?

Mr. **Arai**. The prime rate is 7.5 percent at this time.

Senator **Quayle**. It's 7.5 percent.

What has been the prime rate over the last 10 years? Has it been about that? Has it fluctuated much?

Mr. **Arai**. It has been fluctuating. One time it was up to somewhere around 15 percent. That was back in 1974. But normally it fluctuates in the main between 5 and 15. At this time, it is, as I mentioned, somewhere around 7.5.

Senator **Quayle**. How long has it been around at 7 percent? Has it been the last 2 or 3 years?

Mr. **Arai**. About the last 12 months.

Senator **Quayle**. Was the 15-percent prime rate basically due to the energy situation, the oil? Inflation factor driving the interest rate up in Japan?

Mr. **Arai**. Yes. That took place as a result of the long line recession which had a serious impact on the Japanese economy and also the 1973 labor offensive which raised the wages of Japanese workers to almost a 25-percent higher level over the previous year. This resulted in a tremendous rate of inflation in 1974 and consequently, the prime rate also went up.

Senator **Quayle**. When did the prime rate start to go back down? In 1976? When?

Mr. **Arai**. Well, it started downward in 1978, I believe. It has been declining because we have seen ups and downs. But it has shown the decline since 1978.

Senator **Quayle**. What would be the impact on potential to have growth in Japan if the interest rate goes back up to 15 percent?

Mr. **Arai**. Well, in 1974, 1975, and 1976, we saw tremendous decline in the investment rate because the productivity also dropped sharply from the 13-percent performance level in 1973 down to almost negative 1 in 1974. And this trend continued for a considerable period of time because, unlike the United States, the Japanese economy cannot make adjustments in the denominator productivity measurement that is labor input. We have what we call lifetime employment system. So a down trend in the economy does not enable the Japanese to lay off people or to make adjustments in factory performance. Therefore, we have seen a tremendous decline in productivity performance.

However, during that period of time, the Japanese have concentrated their efforts on the reduction of costs. They have obtained the capability to operate plants at a 60-percent level and still be profitable. That enabled the Japanese to have high growth starting in 1978.

Senator **Quayle**. I want to take off where Mr. Volpe concluded on the potential management of human resources, and I am very familiar and applaud Mr. Cowie and the Scanlon plan and communication system that you have developed. Matter of fact, I have used your example to other management people as an initiative that you can improve the human aspects of our employees.

But the thing that struck me was on page 10 of Mr. Arai's statement where he is talking about the strategy of growth and survival, where Japanese companies now spend about $50 to $150 per employee for training, retraining, and education of the work force. And that this particularly applies when management wants to introduce automated equipment and robots, management sets aside 3 months to 1 year for retraining of employees to be displaced so that they may acquire new skills to fill better paying and more interesting jobs. Typically in the automation process employees are retrained to become sales and maintenance engineers and software specialists.

Now, if we are going to have the introduction of technology, robotics, which we have had testimony before this committee on this, it seems to me that we are really going to have to take this kind of an attitude with the current employees that we have, not only in opening up our communications system, which needs to be done, but really the retraining of some of the current employees that we have. Retraining for the new jobs, so you will not have the reception in a very hostile mannerism that we find so common in this country.

I wonder if you might, Mr. Cowie, Mr. Utt, and Mr. Volpe, comment on what we really ought to be concentrating on as far as retraining some of our workers to get this—to allow this introduction of new technology that is paramount in any kind of growth that we are going to have in this country?

Mr. **Cowie**. I will go first.

I think the thrust of my testimony, Senator, was if we are to have productivity increases in the United States, we must develop in each of our facilities a climate which will accept just that kind of change. I think there is some opportunity here for our Government to provide some social leadership in this area, if we can help our people to understand that the process that we are going to undergo as we raise these levels of productivity is going to involve dislocations, perhaps geographic dislocations but, at the minimum, dislocations of the skills applied to given jobs. And if we can develop the sense in our workplace, that it is going to be important for people to move into other areas of endeavor and, if at the same time, management can provide the facilities to do that, and offer our people this training opportunity, why I think that will be an important element in making this change possible. Because I think we are really on the threshold of a very substantial social change, and there are large forces, human inertia, I guess, that are resisting that kind of movevent and it is absolutely essential that those kinds of things take place before we can make the progress that we are going to have to make.

Senator QUAYLE. What kinds of social leadership do you think that we here in the Congress could take in that respect? Do you have any specifics?

Mr. COWIE. I think you have an opportunity to talk a lot and people will listen to you because you are looked upon as authorities in a number of areas. And I think you need to collectively—I am speaking now not specifically to the members of the panel here—but I think collectively the Members of the Congress ought to take the view that the changes that we are about to undergo are not going to be simple, and they are going to involve human sacrifice and that we need to develop a sense of competitiveness among our people so that each one of our people in the workplace realizes that his competition is not the man next to him but the man maybe 5,000 miles across the water in Germany, Japan, or whatever, who wants to take his job away. And if we can develop that kind of a sense among our people, why I think that that will be an important help to us.

We have a job to do as management, and I am certainly the first to say that management has not done its job well. We have, for decades, to some degree been complacent in the approach to things. So I certainly do not blame the American worker for the state that we find ourselves in. In fact, if the problem rests anywhere, it probably rests on the shoulders of management more than anywhere else. We have a major job to do but we certainly cannot do it alone because every American manager operates in a context created by the press, by the legislatures, by the administration, by the labor unions, and by themselves. And that context has to develop a sense of motion and a sense that we are involved in something very big, and we have to accept the kinds of changes that will have to be made.

Senator QUAYLE. Mr. Volpe.

Mr. VOLPE. Thank you.

I think history has shown that automation creates substantially more jobs than it destroys.

Senator HAWKINS. It takes a lot more?

Mr. VOLPE. It creates a lot more jobs than it destroys.

The problem, I think, is going to be to insure that those individuals who enter the work force have the skills necessary to handle the new jobs. Skill level requirements are constantly rising and we will need to insure that young people completing school come to the plant and to the office able to read, write, compute, and thus have the background skills necessary to handle highly skilled tasks and assignments.

Senator QUAYLE. Senator Hawkins.

Senator HAWKINS. I would like to continue that.

That comment was made, Mr. Arai, almost every time we got back on the bus to go to another rural area to see a phenomenally conceived plan that was a completely robotic controlled plant. The people were there but they were on another floor being trained to do much more interesting work. Our comments would constantly go back to the point that you just made, that their line people were educated so well in the beginning and prior to coming to that job that they have the skills and the ability to be promoted for better training upstairs behind the little curtained room. They were studying engineering and very exciting things because they had come to assembly jobs with a much better education background. And, also, it is almost in the national interest to pursue excellence, you know, a great deal of competition in education, getting in the right school, preparing at a lower level, and I do believe that you have put your finger on what we felt after our trip there, that we were amazed of what was going on and how the laborer can be retrained for higher paid jobs. In America there is a greater fear that they will be here as robotics come into effect. That has not happened in Japan because they start out with a better educated worker.

I would like to comment, fortunately, the dedication is on our committee also. I think most of the problem areas are the labor and human resources. But, it is something that we need to talk about.

Mr. Arai, you answered the chairman that the Japanese interest rate today is 7.5 percent.

Does Japan have a balanced budget today?

Mr. ARAI. No; we have deficits.

Senator HAWKINS. How large is your deficit?

Mr. ARAI. Very close to yours.

Senator QUAYLE. That is pretty large.

Mr. ARAI. Yes, for the country it is one-half of the gross national product.

Senator HAWKINS. One-half.

What is the inflation rate today?

Mr. ARAI. The inflation rate today is 5 percent.

Senator HAWKINS. What is the percentage of debt equity ratio in your country?

Mr. ARAI. The average equity, debt equity ratio is 80 percent, that is 80 percent growth, 20 percent equity. That is average for all the establishments. However, if you just analyze the debt equity ratio of high performance, you find that there is a comparable ratio available to them as in the United States, that they maintain about 50 percent equity.

Senator HAWKINS. A great deal of the capital comes from savings, does it not, from your citizens?

Mr. ARAI. That is correct.

Senator HAWKINS. And as you see a struggle here in the United States to provide tax incentives, tax cuts, in order to produce a larger pool of capital for industry to use, you recommend, as an expert—you have to be an expert because you are many miles away from home, so would you recommend as an expert that this Congress pursue that course we are on in providing tax incentives that encourage business to expand?

Mr. ARAI. Yes. In the past, the Japanese Government very effectively utilized taxing incentives in order to cause the change in the industrial structure and also to have concentrated efforts in certain limited product lines, so that there would not be the proliferation of wealth. Japan, being a country without natural resources and the aggregate wealth of the United States, there has to be concentrated efforts in high productivity, product line. That process took place through the Government's initiative in offering tax incentives as well as low-rate loans to high growth, high variabilities.

Senator HAWKINS. The figures that I brought back, and I would like to let this be on the record for this committee, that the first 3 million yen or $14,500 is exempt from tax for all moneys in financial institutions; is that correct?

Mr. ARAI. That is correct. And if you add up all those exemptions——

Senator HAWKINS. Then we have an additional 3 million yen that is tax exempt if you save in the post office?

Mr. ARAI. Right. That is correct.

Senator HAWKINS. And then you have an additional 5 million yen or $24,000 that is tax exempt for savings with your employer, is that correct?

Mr. ARAI. That is correct.

Senator HAWKINS. So, that would be a total of $54,000 of tax-exempt savings for individuals, is that correct?

Mr. ARAI. That is correct.

Senator HAWKINS. Which provides a great pool of capital for industry to borrow from, correct?

Mr. ARAI. Yes. That is one of the reasons why Japanese save almost 21 percent of their disposable income.

Senator HAWKINS. And obviously, you credit the savings incentives for improving Japan's productivity?

Mr. ARAI. Well, that helps companies to acquire new plants and equipment which result in productivity increase.

Senator HAWKINS. It is just a thought I would like to share with you.

Senator QUAYLE. That sounds like a pretty good deal.

Senator HAWKINS. Could you describe, and you may pick the industry for me, how MITI uses what we call administrative guidance to help industry to improve its productivity?

Mr. ARAI. Well, the administrative guidance is a rather subtle message of forcing certain companies, certain industries, to proceed toward a certain direction which MITI considers to be the most appropriate one. It is in no way considered to be the edict on the part of the companies, but because of the working relationship business has with the Government, and Government takes into consideration the voice of business, that usually you see the business complying with the administrative guidance enforced by the Ministry.

Senator HAWKINS. Is such a system possible in the United States according to your information?

Mr. ARAI. I doubt very much if that sort of system could be applied in the United States. To begin with——

Senator HAWKINS. Would it not be Government intervention into private enterprise?

Mr. ARAI. Yes, I suppose you can interpret it as Government intervention. However, I think that even in the United States currently that you have many Government interventions in the private sector in many different forms, of course.

Certainly, some sort of administrative goal in leading industry into an area where they have never been before, one seen as a promising area for the future, but the Government might become necessary, so that you can have change in the industrial structure of the society itself. The Government in our case, plays the role of the planner rather than an enforcer of regulation.

Senator HAWKINS. And all industries have input into MITI as I understand?

Mr. ARAI. Well, certainly in accomplishing the goal, a certain degree of cooperative effort might be required. Particularly, when we go into the development of higher sophisticated technology which requires a substantial amount of money which cannot be invested by a single company.

Senator HAWKINS. Which of the industries, that you feel, MITI feels, it is more likely to encourage and discourage in the future by tax incentives, loans, or grants?

Mr. ARAI. Well, I believe MITI identified in their 5-year national project planning that production or development of fifth generation computers, sophisticated, intelligent robots by engineering, airframe production.

Senator HAWKINS. You said airplane?

Mr. ARAI. Airframe.

And, of course, the development of solar energy is included at this time.

There are many other minor projects. I am sorry, I left out the optical fiber.

Senator HAWKINS. How is this decided, which business?

Mr. ARAI. MITI has an advisory committee called the Industrial Structural Council, which is composed of approximately 130 representatives of various sectors of the society. Members of the faculty of the leading schools, industry representatives, union representatives, consumer representatives are divided into several committees, and they study the future potential of emerging industries. Based upon their findings, they make recommendations as to which industry might be considered a growth industry in the future. This is actually the reflection of the voice of business as well as other public sectors, and MITI usually, depending upon the advice of such organizations, determines the national project which is considered to be important for the future of Japan.

Senator **Hawkins**. As I understand it, they do all the research then at the top, planning, and then decide which company, for instance, shall take over that production of that project.

Mr. **Arai**. Well, in the stage of development of a new technology, sometimes MITI selects about a dozen companies to undertake the particular developmental model. Depending upon their expertise, of course, the portion of the project that they undertake is different. But, MITI plays a leading role in selecting those companies because those companies can volunteer to participate in the program. Any other company can volunteer to participate in the program, but we have a basic understanding as to who has expertise in certain areas, so, in most of the cases, those companies selected go along with MITI's designated role and project.

Senator **Hawkins**. It is really a fascinating concept to us, and I think that we really have legal barriers to do anything like that in the United States, and it may be something that we have to look toward.

A recent Joint Economic Committee study said that:

> Japanese markets should remain quite distinct from those of Anglo-Saxon countries. Structural characteristics, such as retailing competition, effective syndication, long-term credit banks and government financial institutions give the Japanese system some notable strength that Anglo-Saxon counterparts lack. It is an ingenious mechanism of pooling and diversifying risk at a national level.

What aspects of this system could be applied to the United States to increase the amount of capital to fund productivity and enhance productivity, in your opinion, Mr. Arai?

Mr. **Arai**. The tax incentives generally available to the public for savings will be quite useful in encouraging the savings by the public. Certainly, to make the money available to private sectors, a substantial portion of that money has to come from the savings institutions rather than relying upon the equity which will be susceptible in the decisionmaking process to lend to investors.

Of course, other tax measures that the Japanese utilize in order to encourage investment in a certain product or equipment, would be quite helpful. For instance, there is an identifiable tax exemption in the range of 13 to 14 percent in Japan in large size computers, industrial robots, pollution control equipment, and the numerical computer machining tool. Obviously, the indication is that they are encouraging the modernization of the machining industry which composes 25 percent of manufacturing operations. Their goal is to highly automate that sector first and then move on to the manufacturing, assembly operation, and the manufacturing sector.

Certainly, I believe that if a nation wants to improve the environmental quality, then the tax incentives that the Japanese Government gives to purchasers of pollution control and abatement equipment in the range of, say, for instance, 20 percent would be helpful in diverting available funds in the direction the public desires the corporation to invest. Of course, that type of policy might be called choosing the winner or direct government interference in the business. However, I think we are—we will be dealing with the depleting natural resources and energies.

You cannot simply divert those depleting resources to an area where performance is not par with many other sectors, which simply means waste—waste of human effort, waste of energy, waste of raw materials. I do not think in the 1980's, and the 1990's that we can put up with such a waste.

Therefore, I think that some sort of comprehensive program has to be formed so that people have a general idea in which direction society is to proceed. Otherwise, I think they will run into a terrible conflict with the Third World because they will be competing for the same natural resources and energies.

Senator HAWKINS. I have one question of Mr. Cowie.

On my trip to Japan, I spoke with the president of a large Japanese Government factory group, and he made the point that the robots that were manufactured in the United States, as I understand it, that the widespread adoption of robots have tremendously improved their productivity while it freed their workers from dirty and boring jobs.

In your opinion, why was not the United States the leader in this area?

Mr. COWIE. That is a good question, and there are a number of answers.

I think that complacency was one. A resistance to change on the part of company work forces, particularly unionized work forces, and management was another. The economics of robots for sometime were quite poor, and I think many of the Japanese decisions to go ahead and use robots were made in spite of an economic disadvantage, at least at the outset, whereas we tended to focus more on the short-term return on the investment in robots which, up until recently, were quite high priced. The Japanese have perhaps looked more at the human factor and said that as a matter of principle, we want to move forward in this robotics area because, some years ahead, it will be important for us to have done that. And, therefore, they have done it in spite of the short-term economics. We have been misled by a short-term view of where our economic interests lie.

Senator HAWKINS. Does your company have any plans on using robots?

Mr. COWIE. The nature of our manufacturing operation is such that robots are not immediately usable on a large scale. But we certainly are planning to use them in the future.

Senator HAWKINS. As presently defined. There may be a futuristic robot sitting out there.

Mr. COWIE. The robots tend to be used in large scale, high volume production such as in an automobile company.

Senator HAWKINS. Your company does not?

Mr. COWIE. Our production is structured slightly different from that.

But let me not leave the answer there because, as you have already suggested, Senator, the technology of robotics is changing very rapidly, and it is far more applicable to the kinds of flexible manufacturing facilities that we have now than it was in the past, and we are embarking on a fairly heavy effort to introduce robots into our production facilities, working together with some universities that are prominent in that area, and with our own people. Our own center of technology has become quite active in robotics.

Senator HAWKINS. What does quality control have to do, in your opinion?

Mr. **Cowie**. If you produce something that is acceptable the first time and you do not have to do it over again, it is a considerable improvement in productivity. There has been a feeling that the best way to achieve high productivity was to produce at high volume and then fix whatever went wrong at the end of the production line. I think we were wrong in that, and I think we are discovering now that the American invention of statistical quality control that went to Japan, with Mr. Deming, is now coming back. We are realizing that he was not a prophet in his own country, unfortunately, and we are now adopting many of the techniques that we have known about for a long time, and which our friends overseas have pioneered in of practical use.

But quality control is an important element.

Senator **Hawkins**. Are you familiar with the Deming award?

Mr. **Cowie**. Yes. It is given in Japan. Yes, I have heard of it.

Senator **Hawkins**. There are some companies now, I understand, in America that are trying to—you know, adopt that same type. In fact, I know one company. It calls it the Deming award and how hard they work to get it.

Would that not be a good way to begin quality control?

Mr. **Cowie**. Anything that would increase the focus on quality control in our country would be helpful, yes. That would certainly be one way.

I am not certain of the protocol of these hearings. Perhaps I should wait to be asked, but I would like to comment on your question that you directed to Mr. Arai with respect to MITI involvement. And if I might, just gratuitously, offer my own interpretation of what it might mean to us.

The Japanese association between industry and MITI has long been admired by the United States, not so much because we covet the so-called interference in our business at the decisionmaking level, but because it represented to us a relationship which was at least mutually supportive and friendly and not antagonistic. Unfortunately, our relationship with our Government over the past four or five decades, with a few spurts of friendship, has been one of antagonism.

Now, I think we have recently come to our senses and realized that the horse that pulls the wagon needs to be fed and nurtured, and I think I see that attitude turning around now. There are some areas where the Federal legislative priorities, I think, could be very helpful. The basic tax structure which I think has undergone some healthy changes is one of those areas.

I can tell you that as a result of the tax policy which we have experienced here, there have been very high level of investments which has diverted into uneconomic tax shelters and things of that sort. And to the extent that those things are discouraged, and economic and productive production is encouraged, that will be extremely helpful. Also the basic view of the antitrust law has been quite restrictive in that it has, I think, discouraged some very productive interactions between industries. The Japanese have not done this. For example, and this is just an example really, from the top of my head, when the motor car companies in this country wanting to combine forces to do research and development on emissions control, which was really a legislatively mandated objective and perhaps a worthy one, they were enjoined from doing so because this was thought to be an antitrust violation. And, in fact, what they were attempting to do was to lower the cost of what was fundamentally an uneconomic exercise. While its benefits may have been worthy at the societal level, it was raising the cost of the automobiles. But, in any case, they were enjoined from doing so. On the other hand the Japanese have, if I understand correctly, just assembled a major consortium together with MITI to spend $400 or $500 million on an industrywide level to develop the fifth generation of computers which is going to be at a level of sophistication beyond anything that we have now.

Now, there are some courageous attempts being made by our computer manufacturers in the United States to do the very same thing, but they are living in fear that the antitrust ax will fall heavily upon them if they do so. So I think there are some fundamental policy kind of issues that need to be viewed from that standpoint.

Thank you.

Senator **Hawkins**. I appreciate your contribution to this record. It is a problem we all have to address together, and I think that maybe we have a Government who may be willing to sit down and talk about this.

I was interested in our trip to Japan that we had a Department Secretary of Treasury, and a Reagan representative in the White House, the Secretary of Commerce, and others that will be in policymaking decisions in the future that are still interested in this question as it proceeds to be a bigger and bigger question.

Mr. Volpe, strong incentives are needed to decrease interest rates in this country. I think we all agree on that, and to encourage economic growth. I am a cosponsor with Senator Bob Kasten of a proposal to accelerate the tax cuts. Some are saying it is not time to drive up the deficits, that it is too big already, Wall Street seems to be having a knee-jerk reaction to that deficit which irritates me no end.

However, I believe it makes a difference how deficits are created. Now, if interest rates could go up and not down, and when a deficit is created by ways that stimulate savings, some call it crowding in, I believe is the term the economists like to talk about, if accelerating the tax cuts now or to increase deficits by $20 billion by increasing savings by $30 billion, there will be $10 billion of net new funds to finance new investments and new jobs, if my old math that I learned is correct. We need, therefore, I think, to consider carefully all tax proposals which are before us to achieve this productivity, more likely to be stimulated by a tax cut.

Mr. **Volpe**. I think Dr. Utt should comment on that question.

Mr. **Utt**. We endorsed a speedup in the tax cut from July 1 to January 1, 1982, last December, in recognition that the fiscal and monetary policy package that was enacted last year was heavily weighted, at least in the early stages, toward austerity.

If we look at the economic policy last year, we had very tight monetary policy. Instead of offsetting that with a rather generous tax cut, we find that during fiscal 1981, income taxes went up 70 percent faster than personal incomes. In order to offset this policy of extreme austerity, we encouraged a speedup in the tax cut, believing that the tax incentives were more important at this point than any potential damage that might be done as a consequence of an expanding deficit.

Senator HAWKINS. Either one of you can answer this if you would.

Which industries are most subject to foreign competition, in your opinion?

Mr. VOLPE. Almost all of them are subject to some degree of foreign competition.

A host of mature industries are facing very severe foreign competition. Our high technology industries are beginning to face strong foreign competition. The foreign competition we face now, with respect to our OECD partners, that is, Japan and the industrialized nations of the West, and the rapidly developing economies of countries like Taiwan and Mexico, Brazil, and Hong Kong, will force all segments of the U.S. economy to act in a way that improves our competitive position in the world economy. Failure to measure up to this test will lead us not only to become less competitive, but also to lose our role as the premier nation in shaping world monetary and trading arrangements.

Senator HAWKINS. What kinds of cost-benefit ratio needs to be shown to a manufacturer in order to induce technological change? I investigated and found out that the U.S. Government subsidized the shipbuilding industry for 46 years. We want to talk about where we had some Government help. Can Government subsidies buy improved productivity?

Mr. COWIE. Would you repeat the first part of that question?

Senator HAWKINS. What kind of a cost-benefit ratio needs to be shown to a manufacturer in order to induce technological change, and I used an example that the Government has been involved in subsidizing shipbuilding in the past 46 years.

Do you feel that Government subsidies buy improved productivity?

Mr. COWIE. No; I do not think they buy improved productivity. I think—you mentioned technological change and productivity, and I assume you are linking those two, and I think it is appropriate that you do so.

I think that technology and productivity are both driven by the competitive market and that any subsidy which insulates the industry from the competitive market, as the Government subsidies in shipbuilding have to some degree, would tend to stifle that kind of technological and productivity gain.

Senator HAWKINS. How can labor productivity be improved in the presence of featherbedding practices? Do any of you have comments on that?

Mr. UTT. I think you are seeing, under the pressure of economic stress and international competition, an enormous adjustment on the part of American labor. Free trade is doing precisely what it is supposed to do—keeping our business, our labor, and our investors on their toes for new opportunities. The kinds of concessions we are seeing now in a number of our leading industries will make an important contribution toward improving our productivity in those areas.

Senator **Hawkins**. I appreciate all of you gentlemen staying late today. I am sure you intended to get out by 12 o'clock, as did the chairman. He asked me to thank you for your contributions to this record and to tell you that it is a subject of vital interest to this Congress, to our citizens. I would say that the mail we received is increasing as is the communications and the impact of foreign competition and productivity come to the forefront in helping us out of the economic mess that we find ourselves in today.

So I certainly do appreciate this beginning dialog with you gentlemen, and I look forward to working with you again. And thank you for appearing today.

We will conclude the hearings at this time.

[Whereupon, at 12:45 p.m., the subcommittee adjourned, subject to the call of the chairman.]

PRODUCTIVITY IN THE AMERICAN ECONOMY, 1982

FRIDAY, APRIL 16, 1982

U.S. Senate,
Subcommittee on Employment and Productivity,
Committee on Labor and Human Resources,
Washington, D.C.

The subcommittee met, pursuant to recess, at 9:15 a.m., in room 4232, Dirksen Senate Office Building, Senator Dan Quayle (chairman of the subcommittee) presiding.

Present: Senator Quayle.

Senator **Quayle**. The committee will be in order.

We are pleased to welcome our guests to this hearing on productivity in the American economy. The question is how do we get productivity and how do we improve it. We will discuss the question of the role of the Federal Government and what the Federal Government can do or should do to try to solve the problem. At a minimum, we must certainly maintain fiscal policy aspects of how this applies and factors into productivity.

Today we are going to listen to potential solutions to the productivity problem and focus on antitrust policy in an effort to increase the growth of productivity in our Nation. Productivity growth slowed to a crawl in the 1970's. We want to see that completely changed in the 1980's.

Today we have as our leadoff witness from the Department of Justice Mr. William Baxter, who is Assistant Attorney General for the Antitrust Division. On behalf of the committee, Mr. Baxter, we thank you for participating. You may proceed at your pleasure.

Mr. **Baxter**. Thank you very much, Mr. Chairman. I have submitted a fairly long statement to the subcommittee. I do not think it would be useful to go through it all. With your permission, I will merely touch on the highlights of that statement and answer any questions that the committee may have.

Senator **Quayle**. Without objection, your prepared statement will be inserted in the record at the conclusion of your testimony.

STATEMENT OF WILLIAM F. BAXTER, ASSISTANT ATTORNEY GENERAL, ANTITRUST DIVISION, U.S. DEPARTMENT OF JUSTICE

Mr. **Baxter**. Mr. Chairman, antitrust policy should be totally congruent with efforts to increase productivity. The central theme and purpose of antitrust enforcement is, or at least should be, the maintenance of competitive markets which will achieve efficient resource allocation and attain the maximum possible output of goods and services from our always limited stock of resources.

Labor, of course, is one of those resources. At least the traditional definition of productivity is maximizing output per labor hour. The most elementary feature of antitrust that works in that direction is the prevention of cartel-type behavior, which always involves the deliberate restrictions on output for the sake of increasing prices, a very costly kind of behavior in terms of economic efficiency and productivity and the central target of our efforts. Very similar in kind is our concern about merger activity, which significantly elevates the risk that collusion will occur in particular industries. There, too, we play a very active role.

The merger situation is quite different from the cartel situation in that, although mergers can in some contexts give rise to very much the same kinds of losses as cartel behavior—that is to say, when they facilitate and make more probable cartel behavior—mergers are far more often important instruments in the workings of our capital markets and, if not absolutely essential, are very close to essential to the continuing redeployment of existing productive capital investments and to the redistribution of capital for investment throughout the economy.

So, the problem there is to sort wisely, to prevent those mergers which significantly threaten to facilitate collusion in markets which are already concentrated, but keep the road open for the great preponderance of mergers which are either beneficial or neutral in terms of efficiency and productivity. In my statement I canvass quickly our actual conduct with respect to merger examination last year, but I will not go over that ground here.

Although antitrust policy should be totally congruent with efforts at efficiency and productivity, regrettably that has not always been the case. I have in mind three areas that I will mention this morning where I think at least at times in the past antitrust has interfered significantly with efficient business behavior and, therefore, with productivity.

One of these is in the general area of vertical arrangements. A company can choose to structure its organization in a variety of ways. It may engage in extensive vertical integration. It may mine its own ore, carry it to its own blast furnaces, produce its own iron, steel, rolling mills, fabrication, if necessary, all the way to the final customer. Or it may choose to perform a limited set of those functions and buy its supplies on the spot market, and sell its output under spot market types of conditions. We have no objection either to a company deciding to limit the scope of its vertical integration or, indeed, to extend the scope of its vertical integration, at least when it does so by internal growth.

Nevertheless, and quite anomalously, in view of the fact that we have never presumed to interfere with private decisionmaking about degrees of vertical integration, when a company decides not to engage in full-fledged vertical integration but nevertheless to do something other than engage in spot market transactions either on the supply end or on the sales end, when it attempts to attain some degree of coordination with its suppliers or with its customers, but a degree of coordination that stops short of full integration, such as entering long-term supply arrangements or requirements contracts or restrictions on the areas within which its customers can resell, we suddenly exhibit enormous concern and find these activities highly suspect. That is very regrettable.

The reason a company chooses to engage in further full-scale vertical integration or not to is because it has reached a private conclusion that it is more profitable, which is to say costs will be saved, to engage in further vertical integration or not. The very same thing is true when a company, rather than engaging in either one of those polar types of behavior, enters these kinds of vertical contractual arrangements either on its supply end or on its output end. Arrangements of this type are very, very rarely in fact anticompetitive. The extensive interference with them that has characterized antitrust law at times in the past is very unfortunate and very harmful to innovation and the restructuring of business organizations and methods. Certainly, one of my principal endeavors has been to cause antitrust doctrine to withdraw in those respects.

I do not mean to suggest for a minute that all such arrangements should automatically be blessed; that is not true. There are circumstances under which such vertical contractual arrangements can be anticompetitive, but they are reasonably easily identified types of situations where such arrangements may be anticompetitive. They can be prevented surgically when those danger signs are present without the erection of sweeping prohibitions that would carry away the good with the bad.

The tendency toward oversweeping per se rules has been one of the primary vices of antitrust in the past and one which we are trying very hard to change.

A second area that I would touch on briefly is the interface between antitrust law on the one hand and various bodies of law having to do with what I call intellectual property on the other. The patent system is an example, but I could equally well talk about copyrights, trademarks or trade secrets. We create these bodies of law precisely because we think, and quite rightly so, that there would be too little investment in the process of innovation if we did not create them. They are purposefully created monopolies in order to solve a problem of market failure which would lead to too little investment if everyone else could immediately copy an innovation that the innovator had made. No one would have much incentive to engage in innovation under those circumstances.

I know of no better device to perform this important function of encouraging innovation. Indeed, the only other possibility that we have ever found or ever used is Government subsidization, and this requires the Government to pick winners in advance. The problems involved in the allocation of those subsidies are very, very substantial. The argument that we should engage in more extensive reliance on Government subsidization of innovation rather than use our systems of intellectual property law seems, to me, very unpromising; indeed, it is an argument that is rarely made explicitly. Nevertheless, because our systems of intellectual property do involve the creation of exclusive rights to use what one has created, it is not inappropriate to say that they create monopoly positions, and that phraseology is often used. That phraseology immediately suggests, but suggests quite falsely, that there is a kind of tension or a conflict between the antitrust laws on the one hand and the monopolies that are associated with intellectual property on the other.

In response to that wholly false tension, the courts in earlier periods of time have interpreted the antitrust laws in ways that intrude very, very extensively on the ability of an innovator to take advantage of, to exploit, to license intellectual property which he has created. That, too, is an area of serious concern, one where, at least for the present, we will attempt to work by urging that courts take advantage of the now rather more sophisticated set of perceptions about the proper nature of the interface between antitrust and intellectual property and withdraw some of the ill-conceived restrictions that they have created in the past. If that endeavor is not successful, a legislative revisitation of that interface may be needed and would certainly be important and appropriate.

The final area that I would like to touch on briefly is the area of joint ventures. Here I have in mind importantly but not exclusively joint ventures to engage in research. In the joint venture area, too, there have been in the past ill-advised cases that embraced or created unduly sweeping per se type rules. Thus, there have been suggestions in those cases that joint ventures between horizontally related competitors are always, or at least almost always, bad and violations of the antitrust laws.

There is no occasion for such a sweeping prohibition on joint ventures. It is often true that the existing scale economies associated with research efforts are far more extensive than are the scale economies associated with the production or distribution activities in the industries to which that research pertains. To insist that each company do its R. & D. on its own is either to insist that the companies be of appropriate size to engage in manufacturing and distribution and therefore do research at suboptimum scale for research, or there will be occasions when the scale economies, the level of research, will be so important that they will lead to the existence of firms which are unnecessarily large and thus create unnecessary concentration at the level of manufacturing and distribution.

We should be more sensitive to this problem, more permissive of the formation of joint ventures at the R. & D. level. They can, of course, pose problems if a very large fraction of the firms in the industry are all members of the same joint venture, but it will be frequently true that clusters of firms can get together and form joint ventures and there will be room in the industry for a half a dozen or 10 or 20 joint ventures where scale economies can be attained and where it is possible to attain all the competition that is needed between the different joint venture groups so that little or nothing by way of competitive force will be lost by permitting the joint ventures.

The argument is made that a third or a half or perhaps more than a half of the firms in an industry must be members of a single joint venture. Then indeed serious competitive problems are posed. We would propose to continue to look at such situations very closely. But, where a joint venture is not so encompassing that it prevents the creation of three or four or five more joint ventures of similar size among firms who are not members of this first joint venture, our attitude should be more permissive than it has been.

I will desist there, Mr. Chairman, if I may, and answer any questions the subcommittee might wish to put.

[The prepared statement of Mr. Baxter follows:]

STATEMENT

OF

WILLIAM F. BAXTER
ASSISTANT ATTORNEY GENERAL
ANTITRUST DIVISION

Mr. Chairman and Members of the Subcommittee: I am pleased to be here this morning to discuss with you the Justice Department's antitrust enforcement policies and how those policies relate to economic productivity.

The fundamental premise of our economic system is that the free market will achieve the greatest possible efficiency in the allocation of resources and thereby yield maximum productivity. The federal antitrust laws were enacted to safeguard the processes of the free market. One of my principal objectives since joining the Department has been to attempt to ensure that the antitrust laws are enforced and interpreted to achieve that goal. I will briefly describe today some of the means we are using at the Department to accomplish this objective.

A. Cartel Behavior

Perhaps the clearest example of behavior that restricts competition and thereby limits economic efficiency, consumer welfare and productivity, is cartel activity. Cartel-type behavior--such as minimum price fixing, market allocation, bid-rigging, supply restrictions, or comparable agreements among horizontal competitors --has been and will remain the primary target of the Antitrust Division.

We meet such behavior with criminal indictments, and we seek to indict responsible individuals whenever possible. We also recommend jail sentences and substantial fines as a matter of course. Since I took office last year, the Department has secured indictments against 79 corporations and 73 individuals for engaging in cartel behavior.

Stiff sentences continue to be imposed in such cases. In fiscal 1981, individuals were sentenced to serve more than 7,000 days in jail, more than five times the total for 1980. The total number of jail days imposed so far in fiscal 1982 is 3664. Individual and corporate fines imposed in fiscal 1981 totalled $16.2 million, up substantially from the $9.3 million total for 1980; the total so far for fiscal 1982 is $16.3 million. By seeking to impose such fines and prison sentences, the Department hopes to deter cartel activity and to prevent the consequent losses of consumer welfare and productivity.

B. Mergers and the Merger Guidelines

Responsible enforcement policy in the merger area is also important to increased productivity, for two distinct reasons. First, it is important to prevent mergers that could enhance the risk of cartel behavior. Second, it is important not to interfere with competitively neutral or procompetitive mergers, because such interference could seriously impair existing capital market mechanisms for ensuring that assests are put to their most productive use.

The law requires enforcement agencies and the courts to determine whether a particular merger or acquisition under consideration threatens significantly to lessen competition in a particular product and geographic market. While mergers or acquisitions have traditionally been categorized as "horizontal," "vertical," or "conglomerate," depending on the prior relationship of the parties, the common denominator in all merger analyses is whether the proposed transaction creates a significant potential for adverse horizontal effects in any realistically-defined market.

Challenging potentially anticompetitive mergers remains an important part of our enforcement program. Last year we challenged certain aspects of DuPont's acquisition of Conoco, and allowed the transaction to proceed only after specific competitive problems were resolved. We also challenged an acquisition in the cigar industry and recently agreed to a consent decree that will prevent unacceptable increases in industry concentration in that industry. Just a few months ago, we filed a complaint and an accompanying consent decree requiring Baldwin-United Corp. to divest competitively overlapping entities in conjunction with its acquisition of MGIC Investment Corporation.

Sometimes we can achieve our merger enforcement objectives without bringing suit by announcing our intentions to challenge a potentially anticompetitive merger. For example, we concluded last year that the G. Heileman Brewing Company's proposed acquisition of the Jos. Schlitz Brewing Company threatened to lessen competition substantially and announced we would sue to enjoin it. That announcement caused the parties to hold the proposed merger in abeyance while they considered other possible alternatives. Similarly, our announced intention to file suit against a proposed merger in the plastic pipe fitting industry prevented an anticompetitive transaction in that industry from being consummated. Thus, we remain fully committed to vigorous enforcement action against transactions that threaten adverse competitive consequences.

On the other hand, it is equally important not to interfere with proposed acquisitions that may be competitively neutral or procompetitive. Unfortunately, there has been some confusion in the law in this area. In its Brown Shoe decision 1/ the Supreme Court emphasized the need to consider a wide variety of factors, but provided little if any practical guidance as to how those factors should be evaluated and weighed in reaching an ultimate conclusion as to the legality of a merger under Section 7. The courts in subsequent merger cases, after endeavoring to cope with the unstructured inquiry suggested by Brown Shoe, began to place primary emphasis on simplified assumptions about the competitive effects of transactions they were called upon to review. Thus, for many years after the Supreme Court's 1963 opinion in Philadelphia National Bank, 2/ judicial analysis was confined almost exclusively to historic data on market concentration and the market shares of the combining firms. Such analysis reflected, I believe, the static structuralism found in the economic literature of the 1930s and 1940s pertaining to competitive behavior and concentration, as well as a desire to simplify the analysis of such transactions for reasons of judicial economy.

Industrial organization literature has become far richer and more sophisticated since those early years, and it has become increasingly clear to economists and legal scholars that some

---

1/ Brown Shoe Co. v. United States, 370 U.S. 294 (1962).

2/ United States v. Philadelphia National Bank, 374 U.S. 321 (1963).

overly simplified assumptions about the probable effects of mergers are now untenable. The courts, too, during the last six or seven years have begun gradually to reduce reliance on a limited set of numerical formulae and to favor a broadened analysis that permits consideration of additional factors relevant to a realistic assessment of the likely competitive effects of any proposed transaction. For example, in the General Dynamics case, 3/ the Supreme Court held that while historic market shares alone may establish a prima facie case, the inference of illegality may be rebutted by evidence that such market shares do not accurately reflect present and future competitive conditions in the relevant market. The Court has also emphasized the need for realistic market definitions, and has required credible evidence that expansion through acquisition into a market in which a firm has not previously competed actually poses a threat to competition in that market. 4/

The merger enforcement policies of the Department have generally followed the evolution of the law in this area. As a result, the Department has concentrated its efforts in recent years on those mergers or acquisitions most likely to affect adversely horizontal competition--that is, transactions between actual or potential competitors. This is not to say, however,

---

3/ United States v. General Dynamics Corp., 415 U.S. 486 (1974). See also United States v. Citizens & Southern National Bank, 422 U.S. 86 (1975).

4/ United States v. Marine Bancorporation, Inc., 418 U.S. 602 (1974).

that every merger that we challenge involves firms that are direct competitors or that we ignore possible horizontal effects produced by mergers between firms that do not have such a relationship to one another. Mergers may affect horizontal competition adversely even if there is no direct horizontal overlap of the sales of the parties to the transaction as, for example, where potential competition is eliminated. Moreover, despite the emphasis on market share and concentration data, we have not ignored other pertinent factors in determining whether to challenge particular transactions.

Unfortunately, the Department's officially published Merger Guidelines have not been modified over the years to reflect this evolutionary process. The Merger Guidelines were issued in 1968 to help the bar and the business community understand the Department's enforcement intentions with respect to mergers and acquisitions. At that time, it was contemplated that those guidelines would be revised as necessary to take into account future developments. 5/ Although the Department's enforcement policies have continued to evolve with new economic thought and judicial interpretations of the Clayton Act, its Merger Guidelines have remained unchanged since they were first published. As a result, they are not now an accurate summary of current law, economic understanding, or our actual enforcement practices.

5/ See, e.g., Department of Justice Press Release, May 30, 1968 (announcing the release of the merger guidelines).

We are now devoting substantial efforts to correcting this situation by revising the Merger Guidelines. I expect these revised guidelines to be completed in the next few weeks and believe that they will be of substantial assistance to the business community and the antitrust bar in understanding our enforcement intentions. Our goal is to develop a concise statement of the analysis that the Department will undertake in assessing the likely competitive effects of a merger or acquisition. Formulating workable guidelines in this very complex area is a challenging task, but we believe that we will be able to provide guidance that will help to deter anticompetitive mergers and, at the same time, avoid interference with procompetitive or competitively neutral transactions. In that manner, the guidelines will contribute to productivity and consumer welfare.

C. Vertical Practices

Just as Section 7 of the Clayton Act and Section 1 of the Sherman Act should not be used to prevent mergers or acquisitions which are procompetitive or competitively neutral, Section 1 of the Sherman Act should not be used to prevent procompetitive or competitively neutral arrangements that fall short of full economic integration. A particular firm may choose complete vertical integration, providing its own raw materials, manufacturing its products, and distributing those products to final consumers through its own outlets. On the other hand, a firm may desire to perform only some small subset of these functions, purchasing on the open market from those at previous stages of the production process, and selling on an open market to those at subsequent stages. Between these two extremes, however, there is a great variety of methods available to a firm to achieve some measure of coordination with independent firms at different vertical levels, without the necessity for full integration. The firm's decisions in this regard will generally be based on its assessment of the relative efficiencies associated with the mix of possible options --full vertical integration, partial integration through contractual relationships with other levels, and dealing only on spot markets for both inputs and outputs. Because efficiency is the usual motivation for such choices, there is every reason for antitrust law to respect them, absent some apparent anticompetitive threat. By preventing only those arrangements that are truly anticompetitive, Section 1 will serve to promote the efficient use of resources and thereby enhance productivity.

One area of concern is the application of Section 1 of the Sherman Act to vertical distribution arrangements adopted by manufacturers. Territorial restrictions or resale price maintenance may, under certain circumstances, be used to facilitate collusion among horizontal competitors and thus give rise to cartelization. Lawyers, economists, and the courts have increasingly recognized, however, that such restrictions do not universally or even typically carry that threat. Current economic analysis demonstrates that an individual firm's choice as to certain distributional arrangements, such as the granting of franchises or the grouping of goods and services for sale, may simply reflect the firm's judgment about the most efficient way to structure its marketing effort. Manufacturers, dealers, and consumers may benefit from the resulting strengthening of interbrand competition.

Relying on these developments in economic learning on vertical distributional practices, the Supreme Court in its GTE Sylvania decision 6/ held that a "rule of reason" approach, which would proscribe a practice only where an overall adverse effect on horizontal competition could be demonstrated, was required in a case involving manufacturer-imposed restraints on the location of dealers. The Court's decision reflected the more sophisticated analysis of the purposes and effects of vertical practices that has developed in recent years, recognizing that overly rigid prohibitions may inhibit innovations in the structuring of businesses and, thus, severely limit efficiency and productivity. We believe that this decision has correctly pointed the way for the analysis of vertical practices.

The Department of Justice is following such a fact-intensive, case-by-case approach to vertical distributional practices in its enforcement policies, challenging only those practices that threaten horizontal competition. Vertical distributional practices are most often at issue in private litigation, however. Accordingly, we have announced our intention to participate in private litigation where we can make a significant

---

6/ Continental T.V., Inc. v. GTE Sylvania Inc., 433 U.S. 36 (1977).

contribution to the development of the law. Although the vertical practices area is not the only focus of our efforts to assist in the development of appropriate legal principles through participation in private litigation, it is presently our primary target. While we have already filed a few amicus briefs at the appellate level, our major efforts are just now getting under way. My staff is in the process of reviewing approximately a dozen requests for our involvement in cases presenting the issues to which I alluded. We are also attempting independently to identify cases in which those issues exist.

Our goal when we participate in such cases will be to promote applications of an appropriate standard, which we view as a "structured" rule of reason. We will urge the courts to consider the type of practice and the characteristics of the product or service involved; and to undertake only that factual inquiry required to reach a conclusion as to the effect of the practice, in light of the economically sophisticated analysis mandated by the Supreme Court. In that fashion, overly simplified rules and economically counter-productive results may be avoided without undertaking an open-ended factual inquiry in each case.

D. Intellectual Property

Productivity can also be promoted through appropriate applications of the antitrust laws in the area of licensing restrictions placed on patents and other intellectual property. The exclusive rights granted with respect to patents, copyrights, trade secrets, and other forms of intellectual property play a crucial role in encouraging innovation and thereby increasing the vigor of the competitive process. Thus, the law of intellectual property complements the antitrust laws, and it is of particular importance that antitrust enforcement officials be sensitive to its legitimate purposes.

In order to maximize the incentives to innovation, firms should be allowed freedom to exploit fully their legitimate patent rights in ways they find most efficient, so long as their licensing practices do not threaten to suppress competition between the patented technology and substitutes for that technology, and so long as no other identifiable risk of suppressing innovation or competition in an industry is created. For example, while patent tie-ins, requiring a licensee to purchase unpatented materials from the licensor, may prove anticompetitive in a few very unusual circumstances, a rigid rule prohibiting them in all circumstances is certainly counterproductive. Such practices may be designed to allow the patentee to charge the licensee an amount that is a closer approximation of the value of the license than would be attainable by forcing the patentee to measure that value by other less direct or more costly means. Further, it may provide licensees with the incentive to practice the patent by using unpatented inputs in correct proportions with the patented item. Where tie-in requirements promote efficiency without damaging competition, they may substantially enhance consumer welfare.

Similarly, other patent licensing practices may seek to increase patent incentives and promote consumer welfare. Thus, the patentholder may place field of use restrictions on licensees, pursuant to which, for example, one licensee is given exclusive use of a patented product in one area while another licensee is given exclusive use in another area. Or a patentholder may wish to place certain restrictions on the resale of the patented product, such as restricting the customers to which the patented product can be resold. As with tie-ins, the Department will scrutinize carefully these patent licensing provisions on a case-by-case basis. We will undertake enforcement actions to block those patent licensing practices, as well as those practices involving other forms of intellectual property, that are harmful to competition, but we will attempt to avoid interference with those enhancing consumer welfare.

E. Joint Ventures

Joint ventures also require a fact-intensive, case-by-case approach designed to determine whether the venture has identifiable adverse effects on horizontal competition. Such an approach is necessary to ensure that only anticompetitive arrangements are proscribed.

Joint ventures may foster efficiencies not available to individual firms, and may promote technological progress and enhance productivity. Such joint ventures should not be deterred by rigid or overly-broad applications of the antitrust laws. The Department's recently published Guide Concerning Research Joint Ventures is intended to assist businesses considering joint ventures by clarifying our enforcement policies in this regard.

For example, as the Guide indicates, an important factor is whether a joint venture leaves a significant number of non-participating firms free to engage independently in research. If there are not a significant number of such non-participating firms, and the joint venture's research could be done individually by the participating firms, antitrust problems could arise.

F. Review Of Consent Decrees

I should also describe briefly our efforts to review consent decrees that have been entered in settlement of past Department antitrust cases. Because of changed circumstances in the particular industries involved, as well as more refined economic thinking in the area of industrial organization, some of these decrees may, upon current analysis, appear to have anticompetitive and inefficient effects. We hope to eliminate any such decrees as a result of our review.

G. The Department's Competition Advocacy Program

Finally, I believe that the Department's role as a competition advocate makes an important contribution to increased productivity. The Department acts as a competition advocate in a variety of institutional settings. Within the Administration, in Congress, and wherever else it is found appropriate, we have persistently identified reliance on competitive markets as the most effective guarantor of productivity and consumer welfare. We have participated actively in support of legislative proposals to deregulate the civil aviation, surface freight transportation, telecommunications, and intercity bus industries, among others. We regularly intervene in proceedings before the agencies regulating those industries--the CAB, ICC, FMC and FCC--to advocate the preservation of competitive forces wherever feasible. In this manner, we hope to promote competition as a more efficient alternative to regulation, thereby fostering maximum productivity and consumer welfare.

Mr. Chairman, that concludes my prepared remarks. I would be happy to address any questions you or the other members of the Subcommittee may have.

Senator **Quayle**. Thank you very much, Mr. Baxter.

In the testimony that we have had up to date, which includes probably about 30 witnesses in 3 days, everyone sorts of goes back and targets the time in our history where productivity began to decline. That time was about 1966 or 1967, at that juncture. It has been on a continuing slide downward. It is sort of leveling off now at a low rate of productivity. Everybody is now trying to get a genuine consensus on how do we get that productivity going back up. I wonder if you might be able to comment on that time period in our history in antitrust law beginning in the late sixties and coming through the seventies, what kind of policies we had as Congress, as administration, as government policies that could have contributed to this decline. You went through these three points that you are concerned about. Then, if you could, just take us up to 1982, where we are today, and to see some antitrust changes or alternatives that could get the productivity going back up on a kind of comparison basis. That is the way it seems that the testimony has gone. It has been in those two segments. I wonder if you might just be able to relate antitrust policy, government policies in that time period.

Mr. **Baxter**. Mr. Chairman, I can do that. Actually, I can make the story sound very good. I would not want to oversell the extent to which I think excessively intrusive antitrust has accounted for the difficulties which we now face.

The mere fact that two things happen at about the same time does not necessarily imply any very strong causal relation between them.

If I were to trace the history of antitrust, about which I have been speaking, I would assert that antitrust law did not much get in the way, that it confined itself to appropriate targets and indeed was in some senses too permissive. It did not reach all its appropriate targets up through the end of the Second World War and into the very early fifties. But starting in 1953, 1954, 1955, there was an enormous expansion in the intrusiveness of antitrust. That pattern continued until about 1973. In about 1973, the Supreme Court, for a variety of reasons, certainly including an increase in the general level of sophistication on the part of the Court, began backing off from some of these quite unwise doctrines. I would say for the last 8 or 9 years certainly the direction of the Court has been very promising. Its speed, in my view, has left something to be desired, but certainly its direction has been a significant improvement.

If one assumes that there is a lag of 3, 4, or 5 years or even 10 years as these policies really take effect in the context of our industrial structure, it fits that pattern of decline quite well. One could make an argument that this excessive intrusiveness has been very, very damaging. I do not believe it is one of the major factors. I would not try to argue that it was attributable for 50 percent or even 33 percent of the difficulties. I do think it has been a significant factor. It would be presumptuous, even preposterous, for me to try and assign some percentage cause to it. But I feel confident that it has been a nontrivial contributing factor to the impairment of our productivity.

Senator **Quayle**. When you speak of excessive intrusiveness as a general policy, do you mean the intervention of Government into the private sector as far as bringing antitrust suits, dealing with mergers, dealing with patents per se, vertical arrangements? Is this basically what you are talking about?

Mr. Baxter. Yes, it is. Only one particular form of Government intrusion is intrusion by the Justice Department and the Federal Trade Commission.

In the antitrust area, one of the oddities is that antitrust cases brought by those two branches of Government represent only about 5 to 10 percent of all antitrust cases brought. The number of private cases at any given point in time will represent 90 to 95 percent of ongoing antitrust litigation. But those private cases tend to come in the wake of cases brought by the Government to reinforce and, indeed, to amplify the steps taken by the enforcement agencies. Of course, that is a splendid arrangement if the agencies are behaving wisely. But it is a very damaging arrangement if they are behaving unwisely. In my view, there was a long period of years during that period where they did behave unwisely and brought this enormous wake of private cases along behind them. It is to that phenomenon that I refer.

Senator Quayle. In the same time period, 1967 through 1982, there have been, I believe, an increase in the number of mergers in this country.

Mr. Baxter. In what time period, Senator?

Senator Quayle. The period of 1967 to 1982. Is that an accurate statement or not?

Mr. Baxter. No, it really is not. There was a very, very substantial peak in merger activity in 1968 and 1969. I could be a little bit off on some of these dates now because I have not reviewed them recently. There was a buildup from the late 1950's and early 1960's to a historic peak in the very late 1960's, I think 1968 and 1969. Then merger activity fell off quite sharply until the early 1970's. The curve started up again at about 1973. It is still on an upward slope. By most well-conceived measures, I think that it has not ever returned to the levels that we saw in 1968 and 1969.

If you measured, of course, in current dollars, one gets the impression that the present level is very high indeed. But, if you use 1972 dollars throughout or 1960 dollars or any other constant measure or percentage of GNP, anything essentially that takes inflation out of the equation, why, it continues to appear to me that the 1968–69 peak was the historic high.

Senator Quayle. Probably the historic high, 1968 and 1969, and then you say it tapered off. Now it is back on a rise?

Mr. Baxter. Yes, that is correct.

Senator Quayle. During that time period, except for 1969 to 1973, we seem to have at least a constant or an elevation in mergers. But at the same time we have this decline in productivity. Is there anything there in saying perhaps mergers themselves would have a detrimental effect on productivity and growth? Is there any evidence of that? In this time period that we are talking about, where we have had this low productivity—and, of course, everybody has an answer to what the problem is. What I am trying to get out of you is the antitrust implications. I would imagine someone could draw from statistics and say: well, we've had mergers; we had an increase; we had the peak in 1969; we are back on the rise, and yet productivity has gone down.

They could further make the argument that the increase in the amount of mergers has a debilitating effect on productivity.

How would you respond?

Mr. **Baxter**. First of all, even if the two curves fit much better than they did, one cannot assume causality from temporal connection. Furthermore, the curves do not fit at all well. Mergers were very high at a point in time when our productivity was relatively high. They were very low in the early seventies, precisely when our productivity seemed to hit a problem of some sort. They have gone from very low to very high at a point in time when productivity has been low and flat.

Temporally, the curves just do not fit well. Going beyond the temporal fit of the functions and addressing myself to causality, it seems to me extremely unlikely that mergers have any negative effect on productivity. Indeed, quite the contrary, as I indicated, I see merger activity as a very, very important capital market phenomenon which moves assets and capital into new and different hands, hands of people who are prepared to bet their own money that they can employ it more profitably, and therefore, more productively than the hands from which it was drawn.

There is every reason, I think, to suppose that more intrusive interference with mergers, interference that went beyond the prohibition of mergers, that threaten the intensity of rivalry within particular industries, would seriously interfere with rather than facilitate improvements in productivity.

Senator **Quayle**. I realize that there are no black or white answers to this. It is exceedingly complicated when you talk about which mergers are going to be efficient in general growth and productivity. I wonder if you could compare for us the merger aspect in the antitrust laws in this country today with that of Japan. Japan is looked to by people as somewhat of a success story, particularly in the way that they have been able to grow. And this is what we are talking about, productivity growth. How do we get economic growth and efficiency, more output for the input? Is there any comparison in the environment of mergers, or antitrust law under which Japan operates compared to the United States that would be a distinguishing factor in the area of productivity?

Mr. **Baxter**. It is very hard to make comparisons across such very broad cultural and political gulfs as are engaged there. Nominally, I do not think the merger rules in Japan are very much different than our own. They have a Japanese Fair Trade Commission that enforces their antitrust laws. We meet with them once every 6 months and talk with them. Their attitudes about mergers are not significantly different than our own.

I think, in the context of the political culture, however, certainly vertical integration and even activities which I would regard as posing fairly serious risks of horizontal collusion are tolerated to a greater extent than they would be in the United States. But that is difficult to say because it is also accompanied by a great deal more Government capital allocation, intrusion, control than characterizes our economy.

INTENTI

BLA

NTIONAL

BLANK

Senator **Quayle**. Is there a point that you could define or a standard that we could assume where in fact mergers as such or the centralization of economic growth in fewer and fewer businesses will weaken our capitalistic society and competition? Is there any credibility in the argument that, if we continue to concentrate economic power in fewer rather than more companies, at some point that would be harmful to the growth and to the basic capitalistic risk in the competitive society that we have and support?

Mr. **Baxter**. I would make a two-part response to that question, Senator. The first half is that the premise which underlies your question is wrong. There has not been any increase in aggregate concentration, to use the words that economists use when talking about this phenomenon, since the early fifties. There was an increase from the end of the Second World War up to somewhere around 1948 to 1953. From that point, if one measures carefully and with a view to getting honest answers rather than producing a result—and that, of course, requires using constant dollars or some other normalized measure—aggregate concentration has been quite flat. That is true without regard to whether you are talking about the percentage of assets in the hands of the largest 200 companies or whatever.

That is true even if one is just looking at the manufacturing sector, where these numbers tend to be highest. But, if one takes into account that over the same general period of time our economy has converted from primarily a manufacturing economy to an economy that is largely devoted to the production of services rather than of manufactured goods, and that there has been a very large sectoral shift from manufacturing to service activities, then, of course, one finds very little concentration of the kind you are talking about on the service side.

If one measures the economy as a whole, as opposed simply to examining the manufacturing sector, which people are implicitly talking about when they make the statements of the kind that constitute the premise of your question, a very powerful argument can be made that a kind of decentralization has been occurring over a number of years. But, if the other were true, I would have, nevertheless, a very difficult time answering your question.

I do not want to say that there is no point at which I would become worried about aggregate concentration. But I do wish to make the point that there is no relationship whatsoever between aggregate concentration and concentration in markets and the attenuation of competition. I ask you to imagine a world in which there were only 50 companies; 100 percent of productive assets and all employment occurs in 50 companies. We would all be horrified by that, I assume, in terms of aggregate concentration. Nevertheless, if each of those 50 companies had a subsidiary in every market in every type of product of roughly equal size, no company would have more than a 2-percent market share in any market. Economists would define that essentially as a perfectly competitive industry.

One must not confuse concentration of market shares in particular markets with the phenomenon of aggregate concentration. They have very little, if anything, to do with one another.

If aggregate concentration is a problem, it is a problem for some reason other than competitiveness. I do not think that problem has ever been well defined. It has never been clear to me exactly what people are concerned about with respect to aggregate concentration. But, if I were to become concerned about aggregate concentration, I would be very clear that antitrust was not the appropriate response because antitrust concerns itself with concentration in markets that lead to attenuations of rivalry.

Rather, the answer—assuming there is a problem—would be the imposition of a progressive value-added tax or some more macroresponse that would attempt to curb the phenomenon of aggregate concentration without interfering with the efficiency of individual markets.

Senator **Quayle**. In other words, the response would be more along the lines of a tax policy, perhaps, than one of a judicial government intervention type?

Mr. **Baxter**. That is what I said, yes. I would want to be sure there was a problem——

Senator **Quayle**. I do not want to put you on record and you are not on record as saying that there is a problem on the aggregate concentration. But, if we got to that, you are saying to me that, even if we got there, the proper response would not be in the area of antitrust. It would be something else like tax policy.

Mr. **Baxter**. Yes. The first solution that would occur to me would be a progressive value-added tax.

Senator **Quayle**. On that particular industry or wherever the problem might be.

Is there a definition that you could give us on what type of mergers would enhance productivity? Is there a certain definition of what type of a merger would see a generation of more growth?

Mr. **Baxter**. I think that is very, very difficult to say. Accordingly, I think we are quite right in our approach, which is not to try and identify mergers that will be highly successful, but to assume that the people who are spending their money to bring about those mergers and whose motivation can only be to make more money are those most likely to be right in judging which mergers will enhance productivity. I attribute no eleemosynary characteristics here. But the only way they can make more money is to make the assets that they have bought produce more productively in their hands than they were producing in the hands of those from whom they bought them. They are putting their money where their mouths are. They are making wagers. My response is to leave them alone unless they have created a situation that I fear will be anticompetitive. It is easier to judge which mergers will and will not, or are likely to be and are not likely to be, anticompetitive by far than it is to judge which ones will be successes and which ones will be failures. Some, of course, will be failures. But, when they make mistakes, they pay heavy penalties; and the market works there, too. They do not remain in control of large sums of resources if they have a history of having made mistakes.

Our function, as I see it, is to interfere with those mergers that are likely to be anticompetitive and to leave the rest to the marketplace.

Senator QUAYLE. If we look just strictly at economic growth and productivity, do you feel that that would be the potential of enhancing those two elements, growth and productivity, will in fact be accomplished by merging of two profitable companies such as Du Pont and Conoco, that this kind of a merger is going to be beneficial for productivity, they will get more efficiency, that will get more economic growth in the end result?

Mr. BAXTER. I do not wish to express any view on the wisdom of the Du Pont-Conoco merger. It would be presumptuous of me to do so.

Very, very intelligent people with a great deal of experience in those industries studied it and made their own bet. I never attempted to assess the probable efficiency of that merger. I did address with great care the question of whether it was likely to have anticompetitive effects in any particular market. I concluded that it was in one particular market. Therefore, we blocked the merger until a particular plant in Chocolate Bayou was gotten rid of. Once they had divested themselves of that plant, we said: "Fine, we see no other troublesome features; go ahead." But we did not say go ahead because we thought it would be an efficient merger. And we had not previously said stop because we thought it would be an inefficient merger. That is not part of our job, in my view.

Senator QUAYLE. Let me take a different situation. Let us take two efficient companies and forget Du Pont and Conoco. Do you think the potential merger of efficient companies is going to enhance productivity, competition, and growth if they make that decision to come together? Or should we examine in a macroeconomic sense the productivity and growth, notwithstanding the antitrust implications; that is entirely different. I am just looking at the growth and the productivity. Is there a consideration that could be concluded from this?

Mr. BAXTER. I would think not. I would hope not. Mergers are expensive to put together. People do not do them just for fun. People are essentially making wagers that they can make these piles of assets perform more efficiently. That is why mergers happen a lot of the time. Now, sometimes they happen merely to take advantage of tax oddities. There are a lot of reasons why mergers happen. It is very hard to sort them out.

On average, they produce gains and efficiencies. That is reasonably clear. We cannot do a good job of distinguishing them. The people who are involved in them are betting that they will work. They will, of course, make mistakes. Some will be disastrous failures. They will have some batting average; assume any batting average you like.

The relevant question is: If we set up an agency of Government to look over their shoulders, people who are not betting their own money, people who will be subject to political pressures of various kinds, will their batting average be better or worse? I am very clear about my expectations in that regard. I would far prefer to let the capital markets work except to the extent that identifiable competition problems are presented.

Senator QUAYLE. Let me make one final statement and maybe pose a question you may or may not want to answer. It just happens to be a personal concern of mine. Before I got into this business, I was in the newspaper business. My mother and father owned a small newspaper in Huntington, Ind., with a circulation of 9,000. The aggregate concentration of power in the newspaper industry is such with chain newspapers gobbling up these smaller independent newspapers, that the independent editor is becoming a thing of the past. It certainly bothers me as an individual who still has an interest in that profession. I do see it happening in that industry. I cannot speak for other industries as I can from that industry.

I can tell you that it certainly is my opinion that it is happening in the newspaper industry in this country. I am not alleging any antitrust problems and I do not want the Justice Department to do anything. But I am very concerned about it. I think it is something that eventually could prove to be very unfortunate.

I do not want to leave the implication or innuendo that chain newspapers are worse newspapers than independent newspapers. I do not want to get into the merits of that. I just want to comment to you, if you want to respond, that I am exceedingly alarmed about the concentration of power in this country in a relatively few in the whole distribution of news and in particular newspapers.

Mr. **Baxter**. I would be happy to comment, Senator. All of my responses to you seem to have two parts today.

Part one: I quite agree with you, but I would point out to you that what you are talking about in that observation has nothing to do with aggregate concentration. It has nothing to do with what percentage of productive assets are in the hands of the largest 200 companies. The enterprises you are talking about are not very large enterprises on the scale of the U.S. economy today.

You are talking about concentration in particular markets in the printed news media. You are talking about the kind of concentration that is of concern to the Antitrust Division, market concentration.

Of course, your observation is entirely right. Over the last 30 years, again perhaps going back to the end of the Second World War, there has been an enormous increase in the scale economies that are associated with newspaper production and distribution and an enormous increase in market concentration in the printed news media.

I can well remember as a child in New York when there were over a dozen dailies, I recall; my number may be a little bit off. One by one we saw them combine into the Sun and the Herald and the Tribune. In the United States today there are very few major metropolitan areas that have more than one daily. That is a phenomenon that is driven by economies of scale. If one is concerned with efficiency or productivity, one has to say: yes, it is efficient, it is consistent with productivity, not the converse.

Part two of my answer is this: Newspapers are very special things as, indeed, the media are generally. When we get talking about newspapers or the media generally, a new concern about concentration arises. It is not the Antitrust Division's kind of concern. It is not the concern of people who talk about so many assets being in the hands of so many companies, aggregate concentration. I do not know what to call that because I do not know what concern that is. But there is a new kind of concern when we start talking about news media, which is simply that of not having getting too few editorial voices, too few points of view about the signifi=ance of events. It is a first amendment kind of concern that is quite different from competitive efficiency concerns. One can make an argument, although I am not prepared to make it this morning, that perhaps we should tolerate a little bit of inefficiency in news media markets in order to sustain a larger number of editorial voices. I would say that the Newspaper Preservation Act is precisely a reflection of that attitude. Whether we need more or less of a push in that direction is a matter of judgment on which I have no opinion, at least not this morning.

Senator QUAYLE. Maybe aggregate concentration is the wrong terminology because that refers to assets. But, if you want to talk about a concentration of circulation, that is the number of readers.

Mr. BAXTER. Market share.

Senator QUAYLE. Market share. That has definitely been concentrated in fewer and fewer hands.

Mr. BAXTER. No question about it.

Senator QUAYLE. There is absolutely no question about it. The phenomenon is there.

I do believe it is a unique situation. It is unique because of the first amendment implications. The old, crusty, independent news editor is becoming a thing of the past, which is unfortunate. Those people are the ones who are hooked into the local community. They are brought up in the local community. They understand it.

As we see this phenomenon in this particular industry, I just wanted to point it out as a point of personal privilege that I have as chairman of this committee. I do not know what to do about it. People in the newspaper business just throw their hands up and admit it is a problem and go on merrily purchasing more papers, those that can afford to, and say it is a problem. But then they argue the product; they tell me what a better product it is. I do not want to get into that, whether it is or is not.

Thank you, Mr. Baxter, very much for your fine testimony. I enjoyed it and you made a contribution to the committee.

Mr. BAXTER. Thank you, Mr. Chairman.

Senator QUAYLE. The next panel is Mr. Shapiro, Mr. Penner, and Mr. Boskin. Greetings, gentlemen. Thank you for coming. First on my list is Mr. Shapiro.

STATEMENTS OF OF ROBERT B. SHAPIRO, VICE PRESIDENT AND GENERAL COUNSEL, G. D. SEARLE & CO.; RUDOLPH G. PENNER, AMERICAN ENTERPRISE INSTITUTE; AND MICHAEL J. BOSKIN, PROFESSOR OF ECONOMICS, STANFORD UNIVERSITY

Mr. SHAPIRO. Thank you, Mr. Chairman. My name is Robert B. Shapiro. I am vice president and general counsel of G. D. Searle & Co., which is a research based pharmaceutical and consumer products company headquartered in Skokie, Ill.

I have a prepared statement which, with your permission, I would submit for the record and move briefly through the points I would like to raise this morning.

I would like to note preliminarily that my views are not necessarily those of G. D. Searle & Co. nor those of the Committee for

Economic Development, with whom I am working on some problems similar to those that are the concerns of the subcommittee.

I do, however, want to note my intellectual debt to the work of the Advisory Committee on Regulation of Industry Structure and Competition, which was part of the 1978 Domestic Policy Review on Industrial Innovation, sponsored by the White House. I would commend to the attention of this committee the reports which came out of that domestic policy review, particularly those of the advisory committee, on which I had the pleasure of serving.

I was pleased this morning to hear that many of the views expressed by Assistant Attorney General Baxter are similar to those that were expressed by the advisory committee in 1978 with regard to the relationship between antitrust and innovation. Innovation is, of course, closely related to the issues of productivity with which you are concerned.

Let me summarize my testimony very briefly.

First, we as a society rely very heavily on the processes of competition as our principal guarantor of economic efficiency and productivity. Indeed, Mr. Baxter's testimony this morning restated quite eloquently, I thought, what in fact is the fundamental premise of our system; namely, that free markets will allocate resources in a way which is likely over the longer term to yield maximum productivity.

I am somewhat less sanguine than Mr. Baxter that antitrust policies of the past or, to a lesser degree, those of the present under his stewardship necessarily contribute to that objective. I would like to describe the basis for my concern.

I should note, however, that I generally applaud the efforts made by this administration to search out the core values of antitrust, to demystify much of the process, and to restrict intervention to those areas in which an identifiable evil can be spotted, and where the benefits of intervention are likely to outweigh the potential risks of intervention.

There is very little empirical data on antitrust. We cannot say, after almost 100 years of operating under the Sherman Act, what the economic effects, the effects on productivity and efficiency, have been. There are serious methodological problems with collecting that kind of data. I am not criticizing the economics profession for not having it, but it is the fact that it does not exist. Therefore, when we are trying to assess antitrust policy in the absence of data, we are forced to rely almost exclusively on economic models which purport to tell us what the impact of a given business practice or a given transaction is likely to be on our competitive system.

In assessing the value of these models, I would ask you to bear in mind that the state of the art in economic model making is relatively primitive. The microeconomic models that we use in antitrust are generated by much the same kinds of processes as the macroeconomic models which we have been using for the last 30 years to forecast our overall economy—the models that purport to tell us what the prime rate will be next year, or unemployment or inflation. I think it would be hard to argue that those models have proven to be highly reliable in application.

It has been said by Bruce Henderson of the Boston Consulting Group, that our current understanding of the nature and dynamics of competition is roughly equivalent to the state of chemistry in the 18th century. I think that is, on the whole, a fair evaluation. In my prepared testimony I discuss some of the specific models on which antitrust relies. Without going into detail, I would like to repeat my conclusion that we do not have any very reliable models to describe the way our competitive system actually works. We have models which purport to describe a situation known as perfect competition, which does not in fact exist in any major segment of an industrialized economy. We have models of monopoly behavior which, apart from those areas of the economy which are regulated by Government, does not purport to describe much of our economy. We have very little in between.

To fill that gap, for the last 30 years antitrust policy has been heavily influenced by a model which focuses on concentration of market share as an inverse measure of competition. Some of Mr. Baxter's testimony this morning relied implicitly on that model.

It is interesting, in view of one of the questions you asked Mr. Baxter, that the concentration model gained prominence in economic thought in the early fifties. It probably reached its peak of acceptance during the sixties and seventies and has been declining in popularity in recent years. I would not claim that there is any correlation between that and our economic performance during that period, but I would note that the kinds of intrusiveness that Mr. Baxter described as characteristic of much of that period are directly attributable to the structuralist model that I am referring to. That model, I think, is passing out of vogue, although there are many who would disagree with me. It is not clear what kinds of models are going to replace it.

My point is simply that at the moment there do not exist any generally accepted models which tell us which levers to pull in order to produce a desired result in terms of competitive dynamics, economic efficiency or productivity.

Given that, and with the further caveat that, as I have already said, little is empirically known, I would like to offer some speculation as to what the impact of antitrust policy may have been on competitive behavior and, therefore, on our national economic performance. There are principally three areas which I think are worth looking at.

The first is, what has been the impact of antitrust policy on leading firms in markets which structuralist theory would describe as concentrated, a description which would include an awful lot of American industry.

I think it is at least arguable that one of the impacts of antitrust has been to discourage the leading firm, the firm with the largest market share in such a market, from aggressively competing to increase that share. My suspicion is, although I cannot prove it other than by anecdote and by inference, that leading firms tend to pursue strategies of short-run profit maximization and market share maintenance, as opposed to longer term market share development. I believe that antitrust considerations play a part in the decisionmaking processes that lead to those strategies.

One of the indicia of that is that there is some evidence, although it is far from clear, that in some industries leading firms may pursue what are called defensive innovation strategies. That is, they are not the first to introduce new technology but, rather, prepare the technology in their research activities and wait for other firms to introduce it before responding themselves with the introduction of that technology. If that is the case, it is bad news for all of us who would benefit from innovation. It is inconsistent with what we normally think of as competition, but it is entirely consistent with antitrust policies which seek to preserve competitors by deterring the leading firm from competing aggressively to increase its market share. I believe it is fair to say that the antitrust risk for such a firm increases as it increases its share of the market. Apart from the issue of innovation, I think there can be little doubt, that antitrust tends to deter leading firms from gaining share by cutting their prices, and I suspect we all pay a price for that.

A second area in which I think some questions can be raised has to do with the merger issues that you discussed earlier with Mr. Baxter. There can be little doubt that antitrust has fostered conglomeration as opposed to horizontal and vertical acquisition. Indeed, a recently published study for the House Committee on Oversight of the Energy and Commerce Committee on merger tactics points out an interesting fact. In the 1948 to 1951 time period, only about 38 percent of all mergers were conglomerate; the others were horizontal and vertical mergers. In 1979, the last year for which data is available, 90.4 percent of mergers were conglomerate mergers.

There is no question that antitrust has been a powerful force in conglomeration. The more difficult question is, what is the impact of conglomeration on economic performance, and you get into pretty deep waters when you try to answer that question. On the whole, I would argue that conglomerate mergers are less likely to produce benefits in productivity than are horizontal or vertical acquisitions.

A third area in which I think there may be reason for concern has to do with joint research, to which Mr. Baxter alluded in his testimony. On the whole, the Justice Department, by issuing guidelines in 1980, has been constructive in enabling firms to determine when joint research would or would not be permissible. But those guidelines are far from definitive, and considerable doubt remains in the field. It is a difficult policy issue. Nonetheless, if you view the kind of large-scale collaboration among firms that marks such successful programs, for example, as the Japanese VLSI program as desirable, it is, I think, quite clear that current antitrust policy under the guidelines would not permit that kind of activity to occur here.

I do not wish to address the ultimate question as to whether that is a good thing or a bad thing, but I think it is an area which you might consider looking into.

Let me conclude with a general observation. As one studies the workings of competitive dynamics in this vast and complex economy of ours and the even vaster and more complex world economy into which we are rapidly becoming integrated, the profundity of our ignorance becomes increasingly apparent. It is an incalculably complex ecosystem. One of the lessons, it seems to me, we have learned over the last decade or two is the folly of massively intervening in complex ecosystems that we do not understand terribly well. I therefore applaud the thrust of Mr. Baxter's testimony this morning, which suggests a more modest role for antitrust intervention at the Federal level.

I would underscore his point, however, that much antitrust policy is not made by the Federal Government; it is made by private plaintiffs bringing lawsuits before district judges, each of whom becomes a policymaker to the extent of that case. That is an issue which I think the Congress might want to consider addressing. If you view unwise or ignorant antitrust intervention as potentially dangerous to competitive systems, as I do, then one would want to have better control over these kinds of intervention than we presently have.

That would conclude my testimony, Mr. Chairman. I would be happy to respond to any questions.

Senator **Quayle**. Thank you, Mr. Shapiro. Without objection, your prepared statement will be inserted.

[The prepared statement of Mr. Shapiro follows:]

TESTIMONY OF
ROBERT B. SHAPIRO
VICE PRESIDENT AND GENERAL COUNSEL
G. D. SEARLE & CO.

BEFORE THE SUBCOMMITTEE ON
EMPLOYMENT AND PRODUCTIVITY
OF THE
COMMITTEE ON LABOR AND HUMAN RESOURCES
U. S. SENATE

APRIL 16, 1982

Mr. Chairman and Members of the Subcommittee:

I am happy to be here this morning at your invitation to discuss the relationship between antitrust policy and productivity. At the outset, I want to commend the Subcommittee for addressing the complex issues which are the subject of these hearings. There surely is no more important determinant of our future prosperity and security than the productivity of our resources: capital, materials, and, most importantly, people. Surely, too, our recent performance, however measured, gives us cause for concern.

As previous testimony before the Subcommittee has amply demonstrated, the factors affecting productivity are many and varied: we have no simple model to tell us what levers to pull to create a national environment conducive to increased levels of productivity. A strong competitive system, however, is clearly an important feature -- indeed, perhaps the most important feature -- of such an environment.

In general, America has wisely chosen to rely principally on the pressures of competition in free markets to guarantee that resources are put to their most productive uses. We have staked our national prosperity on the dynamics of a competitive system. It is not surprising, therefore, that we have had federal legislation for almost a century whose purpose is to assure that the forces of competition operate vigorously and impartially throughout the economy. I refer, of course, to the antitrust laws, principally the Sherman Act of 1890 and the Clayton and Federal Trade Commission Acts of 1914.

There have always been two ways of viewing antitrust policy. One is economic, in which policy is evaluated based upon its effects on economic efficiency and productivity. The second is fundamentally non-economic, in which policy is evaluated based upon its effects on firm size and industrial concentration as such, without regard to efficiency or performance considerations. Proponents of this latter view, support, for example, legislation to prohibit large conglomerate mergers on social and political grounds unrelated to economic performance, such as the replacement of local management control with what they perceive as distant, centralized control. One spokesman for this viewpoint is FTC Commissioner Pertschuk, who has forcefully stated his belief that "antitrust is about the quality of life in a democracy, about the allocation not merely of resources but of power." Professor Victor Kramer refers to this focus on non-economic values as the religious component of antitrust policy.

Since I believe the issue of productivity is best analyzed in an economic context, I will not specifically address these non-economic arguments.

The fundamental economic premise upon which antitrust policy is based is two-fold: first, that antitrust enforcement will tend to promote and support competitive forces; and, second, that those forces will, in turn, promote efficiency, productivity and innovation.

I know of no responsible authority who would question the second part of that premise, namely that competition stimulates productivity. The first part, however -- the premise that antitrust policies tend to promote and stimulate competitive forces -- requires some discussion.

Antitrust contemplates governmental and judicial intervention in the activities of private firms in order to aid competitive processes. Antitrust actions, whether brought by governmental agencies or private parties, seek to deter, prevent or punish private conduct, and, indeed, in major cases under Section 2 of the Sherman Act, to restructure entire industries.

If governmental agencies and courts are to intervene constructively in the competitive system, it is obviously important that they have an understanding of how that system operates -- that they have a model of competition which enables them to assess, with some degree of confidence, the likely competitive and economic effects of the behavior or transaction in question, as well as the likely effects of governmental or judicial intervention. Moreover, it would clearly be desirable to have some systematic way of tracking the actual effects of past interventions in order to determine whether antitrust policy, as applied, in fact has had beneficial results. Without some form of empirical tracking, antitrust enforcement is fundamentally unaccountable.

In my opinion, neither of those conditions is adequately satisfied.

As to empirical data, I think it is fair to say that, after almost a century of experience with antitrust, there is virtually no useful empirical evidence as to the actual effects of antitrust policy upon competition. There are serious methodological problems which make it difficult, if not impossible, to gather useful data on this subject.

This means that discussions about the effects of antitrust policy rely almost entirely on economic models, not on empirical data. Policy is developed by the Congress, the enforcement agencies, and the courts based upon models, sometimes unarticulated, which purport to provide a reliable basis for assessing the competitive impact of a particular business practice or transaction. Consider, for example, the question of whether the effect of a particular merger "may be substantially to lessen competition" under Section 7 of the Clayton Act. The decisions in the enforcement agencies and the courts will, in all probability, rely heavily upon a model which, in substance, treats an increase in market share concentration as equivalent to a diminution of competion. I will have more to say about the concentration model later in my testimony; at this point, I only want to note that the usefulness of Section 7 of the Clayton Act, as applied, is substantially determined by the usefulness of the concentration model on which Section 7 decisions are largely based.

A key question in assessing antitrust policy is, therefore, how good are our models? Do they provide a working understanding of the processes of competition so that our agencies and courts can intervene wisely in the competitive system?

In my opinion, the models used are of widely varying reliability. One model which is clearly useful is that which describes the behavior of cartels: organizations of "competitors" whose purpose is to fix prices, control output or divide markets. A good deal is known about cartel behavior, and it has few, if any, economically desirable consequences.

We also have reliable models at the extremes of industrial organization: "pure" competition and monopoly. The model of pure or perfect competition postulates innumerable buyers and sellers, none of whom can unilaterally effect demand, output or price. In that model, all sellers offer identical goods, entry and exit are costless, and all buyers have perfect real-time information as to conditions in the marketplace.

At the other extreme is the model of monopoly, in which a single supplier, without rivals, has power to control output and prices, limited only at the point at which purchasers can find some substitute for the monopolized goods.

Neither of these models purports to describe any significant portion of the real world, at least in advanced industrial societies. Moreover, neither condition, if generally prevalent, would constitute a hospitable environment for innovation and productivity improvement. While a monopolist may have incentives to reduce costs, he is not driven by competitive anxieties; and even if a monopolist were successful in improving his productivity, he would not thereby contribute towards the kinds of objectives in which this Subcommittee is interested, since those productivity improvements would not be reflected in lower prices. At the other extreme, there is some authority, starting with Joseph Schumpeter, for the proposition that the fragmented state contemplated by the pure competition model is unlikely to nurture significant innovation and concomitant productivity improvements.

I think it is fair to say that we do not have any widely accepted model which purports to describe the competitive dynamics of situations which are neither pure competition nor monopoly. Since we live in a world which is described by neither model, that would appear to be a fairly glaring deficiency and, in my judgment, it is an extremely serious problem for antitrust policy.

Over the past 30 years, antitrust has sought to remedy that deficiency by postulating that, as the number of competitors in a particular market decreases, the market will tend to behave more like the monopoly model than like the model of pure competition, whether as a result of easier cartelization, tacit collusion, or for some other reason. This approach, called "structuralism", treats concentration as an inverse surrogate for competition: increases in concentration are presumed to diminish competition.

As a result, for several decades one of the principal objectives of antitrust policy has been to reduce concentration, or at least prevent increases in concentration, in markets which are seen as concentrated. Moreover, structuralism leads to a focus on market share as a major determinant of policy: in general, the larger the market share of the firm whose conduct is in question, the more intense the scrutiny of that conduct.

Whether structuralism is a useful approach to competitive analysis is highly debatable. In recent years, the momentum seems increasingly to be on the side of structuralism's opponents. There are several reasons for that tendency, which I will only briefly allude to. First, the orginal empirical data which purported to show that firms in concentrated industries earn higher returns than firms in unconcentrated industries has been challenged with considerable success. Second, and perhaps most importantly, newer models of competitive behavior have begun to emerge which suggest, among other things, that the degree of concentration in industry is a natural and largely inevitable consequence of the underlying cost factors involved in that industry and the phase of its life cycle. The emerging models which I am referring to are principally those developed by the Boston Consulting Group and its offshoots, supported by empirical data developed by the Strategic Planning Institute. As these models become more fully developed, I would expect them to have a significant impact on antitrust policy.

In short, I would generally agree with Bruce Henderson of the Boston Consulting Group when he writes:

> "The language of antitrust has been a vocabulary of pejosative expressions: dominance, oligopoly, monopoly, concentration, barriers, umbrellas, predatory, exclusionary, preemptive, collusive, discrimination. Yet these terms are not tied together by any theory of competition, which justifies their role in the prediction of consequences, or of the evaluation of those consequences if they can be predicted."

Antitrust has operated without either empirical validation of its effects or (except as to the cartelization) a workable and generally accepted model of the competitive system as it exists in the real world.

The absence of empirical data and valid models does not in itself mean that the economic impact of antitrust has been useful; it means only that the usefulness of that impact cannot be demonstrated by reference either to data or to reliable models. In turning to the question of the possible effects of antitrust policy on national economic performance, we are forced to navigate by experience, common sense and, to some degree, speculation. Nonetheless, I think some reasonable inferences can be made.

Let me begin with the least controversial area. Antitrust enforcement has unquestionably performed an important national service in prosecuting and deterring cartels. For obvious reasons, price fixing, market division and other such abdications of a competitive role tend to diminish the competitive pressures which contribute to economic efficiency and productivity improvements.

In other areas, however, the effects of antitrust policy are more problematical. One area of concern is the impact of the antitrust laws on leading firms. A firm with leading market share needs to take antitrust risk into account in assessing any competitive strategy the purpose or likely effect of which will be to increase its share. Innovation and productivity improvements may both fall within that category, since they will tend either to confer additional value upon the user or to create cost advantages which can be translated into price advantages. Some evidence, for example, suggests that leading firms may follow "defensive innovation" strategies -- responding to the introduction of innovation by others, rather than introducing new technology themselves. To the extent that antitrust policy skews the perceived risk/reward ratio away from encouraging leading firms to compete vigorously for market share, there may well be productivity losses, not only in terms of the leading firm itself, but perhaps more importantly in terms of the competitive pressures that aggressive behavior by the leading firm would create for other firms in the industry -- pressure which might well stimulate productivity improvements or innovation on their parts. It can reasonably be argued, in my opinion, that, in mature industries, antitrust operates as a conservative and, indeed, anticompetitive force, tending to freeze competitive positions and prevent further competitive evolution.

A second area of concern is the virtual prohibition of significant horizontal and vertical mergers in all but the least concentrated industries. It was, I believe, this aspect of antitrust policy that Peter Drucker was referring to when he said that the antitrust laws "probably are responsible more than any single factor for turning American industry away from building on a technological science-oriented base and toward the financially based conglomerate." I would suggest that, on the whole, the proliferation of the conglomerate form has not produced the productivity benefits that might have resulted from horizontal or vertical acquisition. Professor Michael E. Porter of the Harvard Business School has suggested "selective relaxation of standards for related acquisitions of firms other than the dominant leader." Those acquisitions, Professor Porter says, "can, through opportunities for cost sharing, give rise to real economies and allow followers seriously to challenge leaders."

Relaxation of horizontal merger policy may have particular relevance for productivity in industries which confront rapidly escalating costs for major research and development. Growth through horizontal acquisition can provide the sales base and cash flow to support a minimum critical mass for important research and development work. Similar results might be reached by joint research activities. In that regard, the Justice Department has issued guidelines on joint research which are, I think, quite constructive. It should be noted, however, that the guidelines would almost certainly not have permitted the kinds of large-scale collaborative efforts which the Japanese appear to have employed successfully in their VLSI program.

I would like to offer a few general observations in conclusion:

The competitive system operating in free markets is the mainspring of our present and future prosperity. It is an enormously complex system, at least as intricate and marvelous as natural ecosystems. Any sensible policy on competition needs to begin by recognizing that we have only fragmentary and ambiguous data about that system, and that our understanding of its workings is far from complete. Under these circumstances, a program of massive intervention to improve the way the system works is reminiscent of the tale of the Sorcerer's Apprentice.

Those who favor extensive intervention tend to view competition as a fragile life-form, sustained only by the constant ministrations of government and the courts. The more closely one studies the actual workings of competition, however, the more impressive are its vigor, efficiency and impartiality. In particular, its self-correcting mechanisms deserve, I believe, far greater trust than antitrust policy has traditionally been willing to repose in them.

I believe that the Administration is on the right track, vigorously enforcing the core values of antitrust (principally anticartelization) and evidencing a healthy skepticism about much traditional dogma. Such an approach seems to me to be consistent with a role for antitrust which is genuinely supportive of competition, and, which is likely therefore, to contribute to economic efficiency and productivity.

Senator QUAYLE. Mr. Penner?

Mr. PENNER. Thank you, Mr. Chairman. Those of us who study tax policy prefer to talk about taxes and economic efficiency which, as I point out in the beginning of my testimony, is not always quite the same as measured productivity. The problem with efficiency is that it is both hard to measure and to describe. I think we know it when we see it, but, like a spiral stairway, it is hard to describe without using your hands. Moreover, you cannot simply talk about taxes and economic efficiency. The pursuit of the efficiency goal has to be tempered by concerns over equity. Equity is as hard to measure and describe as efficiency.

My own belief, which I elaborate on in the prepared testimony, is that a progressive consumption tax provides the best balance between efficiency and equity. It serves equity considerations because consumption is the ultimate end of economic activity. Moreover, I have always been impressed with Hobbes' philosophical point, which is about 200 years old, that one should pay taxes on what is withdrawn from the common pool of society's resources, as is roughly measured by consumption, and not on what is contributed, which is roughly measured by one's income.

Efficiency considerations and consumption taxation raise more complex issues. In pure theory, it is not clear whether a consumption or an income tax is more efficient. An income tax creates more impediments to savings and capital formation. But a consumption tax may—and I emphasize the may—be more destructive to work effort.

However, that statement assumes that you can measure income correctly for tax purposes. In a time of inflation, you simply cannot do that without enormous trouble. The main practical problem is measuring capital income. That involves a number of components. It is very hard to measure what true depreciation should be. If you base depreciation on original cost, inflation erodes its value. In times of inflation, you have firms paying taxes on capital gains on inventory, which do not contribute to their real economic purchasing power.

You have the same problem with capital gains on all sorts of securities and other assets. Often, capital gains simply reflect inflation, and yet we tax them.

On the other side, inflation puts a premium on interest rates. A perfect tax law would not allow you to deduct the entire amount of interest but only real interest. On the other side, recipients of interest pay an extra heavy tax because they pay a tax both on the inflation premium, which is only replacing the erosion of the real value of your assets, and on the real interest rate.

In theory you could handle all of these problems with various indexing techniques. But, if you attempted that, the tax law would become so extraordinarily complex as to be unworkable.

In current tax law, errors in measuring capital income result in great inefficiencies because the size of the measurement errors depends on the characteristic of a firm's balance sheet. That varies from firm to firm. It varies from industry to industry. Consequently, different kinds of activities bear different true tax burdens, and capital is badly misallocated in the economy.

I believe that this practical measurement problem related to income taxation is very important and seals the case for moving to consumption taxation. Put another way, I think the strongest case for consumption taxation in the current environment is purely pragmatic. We just do not do a very good job of measuring income in an inflationary period.

The Congress seems to agree with this general proposition. Though it is seldom said explicitly, we are, in fact, moving step-by-step and rather rapidly toward a progressive consumption tax. Over the years all sorts of capital income has been exempted, thus adding to investment incentives reducing the tax burden on capital.

For a variety of reasons which I touch on in the prepared testimony, I think this step-by-step approach is the appropriate one rather than attempting a radical tax reform which would cause all sorts of immediate adjustment and equity problems. But it does create difficulties, and some of these difficulties are severe.

The first point is that we have been moving toward consumption taxation, as I said, mainly by exempting or reducing the tax burden on various kinds of capital income. What that means is, as we continue along that path, the tax rate on what is left over has to be higher to raise the same amount of revenues for the Government. We have been exempting various kinds of capital income without at the same time including more of the income that is used for consumption purposes.

That leaves a very small tax base. But expanding the taxation of income that is used for consumption is extraordinarily difficult politically. If we did it right, it would, for example, involve including transfer receipts in the tax system. That does not mean that you would have to tax poor people or people in unfortunate circumstances. You could design the tax progressively. But, still, it involves a lot of political problems because one of the most obvious things that should be included in taxable income is social security. We know how popular that would be. In fact, any time that you try to broaden the tax base, you run right up against political opposition of one kind or another.

Another problem that we run into in the step-by-step approach is what students of tax law call tax arbitrage. We have over the years and especially in the 1981 tax act attempted to remove the impediments to savings, but we have forgotten at the same time to remove the encouragement to borrowing in our current tax system. The encouragement to borrowing is manifested by the ability to deduct interest on consumer loans and the ability to deduct interest on mortgages. This overall approach is really quite paradoxical from an economic point of view. We continue to encourage borrowing while also trying to encourage savings. But, obviously, it is not so paradoxical from a political point of view.

The end result, however, is a dangerous one. Our tax system now encourages people to add both to the asset side of their balance sheet and to the liability side of their balance sheet. It greatly encourages people to do things like borrow in order to go up to the full extent of the IRA privilege. The IRA privilege essentially eliminates the taxation of the return to qualified savings. So, you get into a situation where a taxpayer in the 50 percent bracket can afford to pay twice the interest rate on borrowing in order to take full advantage of IRA's, and he would still come out ahead as long as the interest rate was not more than twice what he is earning on the IRA account.

When you encourage people to add both to the asset and liability sides of the balance sheet, that is another way of saying that you are encouraging them to become highly leveraged. It is very risky, because it increases the probability of bankruptcy.

It also, of course, means a big revenue loss to the treasury for each additional dollar saved.

So, as difficult as it may be politically, I do believe that the interest deduction on consumer loans really merits attention fairiy quickly. I know we cannot go all of the way, but even a cap on interest deductions would be helpful.

Let me turn very briefly to the corporate tax. A tax on the corporate form is very hard to justify theoretically whether you use the criteria that would emerge from designing a perfect consumption tax or a perfect income tax. It really makes very little sense to have a tax that is dependent just on legal organization and not at all on economic circumstances of the people who actually own the corporation. I think that is implicitly recognized. We have been trying to reduce the capital allocation effects of the double taxation of capital income implied by the corporate tax by devising all sorts of schemes to reduce the tax burden on the new investment. We have over the years been making depreciation more and more generous. We took a big step last year. We invented the investment tax credit in the early sixties, and so on.

The strategy, which I have thought was a good one over the years, was that that provided us with a means of removing the tax burden on new investments while we rather sneakily continued to tax the profit on old investment so as not to lose too much revernue. That is to say it was a device for trying to minimize the investment bang per dollar of revenue loss to the treasury. But that approach only works if the investor has something to deduct the depreciation against or some other tax liability with which he can use his investment tax credit.

We have pushed this strategy so far that many firms have no tax liability left. In the 1981 law, we designed the leasing provisions to deal with this problem. But, as we have all seen, those leasing provisions are extremely unpopular. I think few understand its merits. It appears to the public to be a slightly sordid tax shelter. In fact, it has had all sorts of unintended consequences.

I am afraid that without it the new depreciation law becomes even more distortionary and, I would say, inequitable.

My conclusion from all of this is that we have pursued the strategy of trying to reduce the taxation on the new investment about as far as it can possibly be pushed. I have reached the conclusion that it is time to really change our strategy.

If we must keep the corporate tax, the kind of package of tax policies that is appealing to me is to alter the 3-, 5-, 15-depreciation approach and go directly to expensing of equipment investment. As I point out in the testimony, if inflation comes down and if interest rates come down, that will be slightly less generous than ACRS. At the same time, my plan involves elimination of the investment tax credit and the interest deduction. On balance, all of that would save money for the treasury. Not wanting to tax the corporate form any more, I would use those savings to lower the corporate tax.

It must be admitted that to run expensing perfectly you also need some sort of leasing arrangement or some means of refunding tax deductions and credits. But, if you combine expensing with the lower corporate rate, those distortions are greatly lowered. I think we could in fact get along without it.

That is a radical approach. It is an approach that involves less investment bang for the revenue loss buck, but it is an approach which I am quite convinced now would result in less distortion of the way we use our capital stock and in the long run should be just as beneficial to investment.

It is radical enough that it could not be done immediately. It would have to be phased in. The most severe political problem with this approach is that it would impact different firms very differently depending on the amount of their interest bill and so on.

Before concluding, I cannot resist describing the most inefficient component of our tax system right now, and that is the fact that it just is not raising enough revenue for our spending levels. The prospects of growing deficits in the future, I think, are causing an enormous amount of policy and economic uncertainty. It is adding greatly to our current economic problems. I am afraid that the potential for cutting spending, although I would like to do a lot of that, is just not sufficient to close that deficit quickly. Therefore, I reach the conclusion that we have to raise taxes. I even go so far as to suggest that even bad taxes may be acceptable in order to close what is really a very serious deficit situation.

Senator QUAYLE. Did you say bad taxes or VAT taxes?

Mr. PENNER. Bad. I'll take VAT, too, if you like.

Senator QUAYLE. Without objection, your prepared statement will be inserted.

[The prepared statement of Mr. Penner follows:]

TAX POLICY AND PRODUCTIVITY

RUDOLPH G. PENNER

American Enterprise Institute*

I would like to thank the task force for this opportunity to testify. The views expressed in this testimony are my own and do not necessarily reflect the views of the staff, advisory panels, officers or trustees of the American Enterprise Institute.

Before beginning my analysis of tax policy, it should be noted that increased, measured productivity growth and enhanced economic efficiency are not always the same thing. For example, it is fairly well established that reduced marginal tax rates on work effort will increase the work effort of secondary workers in a family - generally wives and teenagers - more than such cuts will increase the work effort of the primary worker. As a result, a marginal rate cut will result in a work force that is less experienced on average. Measured productivity will fall, but the economy will be operating more efficiently. More will be produced because work disincentives will be lower and people will be happier because they will be able to trade leisure for work income and be rewarded with a more favorable rate of after-tax compensation that more closely reflects their worth to the private economy. In other words, the tax wedge will be lowered between what an employer is willing to pay someone and the net income that the worker actually receives.

My analysis will focus on the effects of tax policy on economic efficiency and not on productivity. The former is more important, but, unfortunately, harder to measure. Most often, however, the two move together.

---

*Views expressed in this testimony are those of the author and do not necessarily reflect views of the staff, advisory panel, officers or trustees of AEI.

As a general rule, a tax system is most efficient when it distorts the pattern of private economic activity the least for a given revenue yield. As with all general rules, there are exceptions. Some private activities generate social costs or benefits that do not directly affect the economic return of the person engaging in the activity. Where a social cost, e.g. pollution, is generated, there is a theoretical justification for penalizing the activity with a heavier tax burden. Similarly, activities conveying a social benefit, e.g. immunizations, may be taxed more lightly or subsidized. But we are not good at using the tax system for social planning purposes, although we often try. We do not have good enough information to do it well; attempts greatly complicate the tax system; and well-meaning policies often outlive their usefulness because all quickly create vested interests who resist change even in the face of changing economic and social conditions.

My analysis will focus on how we best alter the tax system to enhance the efficiency of the private sector. The pursuit of this goal must, however, be tempered by considerations of equity. The most efficient tax system would be one that did not tax economic activity at all. That could be accomplished by levying a head tax where all adults paid the same tax regardless of their level of economic well-being. Obviously, such a policy would not be acceptable and good tax policy involves reaching a balance between efficiency and equity. Since equity is a matter of value judgments and various individuals define it differently, it is not easy to reach a consensus on how a tax system should be designed. Nevertheless, over time, certain principles of equity have evolved that receive widespread support. There is a strong feeling that economic equals should be treated equally and that those who are better off should absorb a larger share of the tax burden than those who are worse off. It is not easy to convert these general principles into operational rules, because there are disagreements over how economic well-being should be measured, and once that is determined, how the tax burden should vary as well-being changes. Note that as soon as tax burdens vary with well-being, a major inefficiency is introduced because economic incentives are diminished.

There are two competing measures of well-being that are often discussed in the literature on tax theory. Some believe that annual income is the best measure because it indicates a person's or a family's ability to consume and to add to net wealth. Income, of course, includes the returns associated with work, capital investments, and rent. Others believe that we should focus on consumption since that is the ultimate end of all economic activity. Still others believe that income or consumption taxes should be complemented with wealth taxes either annually or when wealth is transfered through gifts or bequests.

I personally believe, along with a growing band of tax experts, that, for equity, efficiency, and pragmatic reasons, consumption should serve as the fundamental basis for our tax system. While there are good reasons to complement consumption taxes with taxes on the transfer of wealth, I shall not deal with this complex issue because I cannot conceive of circumstances in which wealth tax receipts would constitute an important component of total government revenues.

Consumption taxation has considerable appeal on grounds of equity, because a taxpayer's consumption is an indicator of his or her own judgment as to how much spending is "affordable" out of income that may vary greatly from year to year and out of various combinations of income and wealth. Moreover, as Hobbes suggested two centuries ago, it seems more equitable to tax a person on what is extracted from society's pool of resources as is roughly measured by consumption, instead of basing taxation on what is contributed to society's pool as is roughly measured by income.

Some believe that consumption taxation is regressive because it is erroneously associated with sales, excise, or value added taxes. These are different ways of levying a tax on consumption, but it can also be done progressively by computing comprehensive income and deducting net saving on a tax form that would look very similar to that used today. A progressive rate schedule would be applied to the residual which, by definition, equals consumption. In practice, the tax would be easier to administer if the proceeds of all asset sales were added to income and all asset purchases were deducted. The difference between asset sales and asset purchases is, of course, net saving.

It is more difficult to say, whether, in the abstract, consumption taxation is more or less efficient than income taxation. Consumption taxation adds to efficiency in that it eliminates all tax disincentives for saving and capital formation. However, the tax base associated with consumption is less than the tax base associated with income. Consequently, marginal tax rates would have to be higher with a consumption tax in order to raise the same revenues, and this may be more detrimental to work effort.

As soon as one turns from the world of pure theory, however, and looks at the world in which we actually live, there is little doubt in my own mind regarding the superior efficiency of the consumption tax. To run an income tax efficiently one must measure capital income accurately and that is virtually impossible during periods of inflation. Current measures of taxable capital income are badly distorted because inflation erodes the value of any depreciation deduction based on original cost; it creates money capital gains on inventory and equity income that do not represent real income, but still are taxed; and it inflates interest receipts and deductions far beyond what should be used as real interest receipts and deductions for tax purposes. On average, higher inflation raises the tax burden on true capital income, but perhaps its worst impact on efficiency comes from the fact that different industries and firms are affected differently depending on the nature of their balance sheets. The allocation of capital is thus badly distorted and we end up using scarce capital in areas where it is less productive than it would be if the tax system were more neutral. Theoretically, the problem could be eliminated by comprehensively indexing balance sheets, but this would be so complicated as to be unworkable. Thus, the most powerful argument for consumption over income taxation may be purely pragmatic. It is simply impossible to measure income fairly and efficiently during times of inflation.

If one agrees with my arguments, it would appear as though we should adopt a pure consumption tax system immediately. Unfortunately, life is not that simple. An immediate shift would involve enormous transition problems which are far from being solved by economists and tax experts. The most difficult is dealing with consumption financed by selling assets that were accumulated under the old tax system out of after-tax income. Moreover, an abrupt shift would create enormous capital gains and losses in different areas of the economy and most would consider these windfall gains and losses to be inequitable.

Therefore, it is necessary to move gradually and we have in fact been doing so. Our current so-called income tax system is a curious and complex hybrid of consumption and income taxation that, unfortunately, does not do a very good job of satisfying the conceptual goals of either approach.

The current tax system treats pension saving just as all saving would be treated in a perfect consumption tax system. Contributions which acquire assets are deductible from income within limits while withdrawals are taxable. Other provisions of the law exempt specific types of capital income from taxation such as that from municipal bonds, all-savers certificates, and, after 1984, a portion of that from all interest bearing securities. Exempting capital income has approximately the same long-run effect arithmetically as making asset purchases deductible and sales taxable, thus leaving the tax burden on income used for consumption.

We are, therefore, moving toward consumption taxation in partial steps along a variety of paths. This ad hoc approach is, however, creating a number of different equity and efficiency problems and it is time to step back and rethink our strategy if we really want the system to evolve into a pure consumption tax.

One problem is that we are effectively reducing the burden of taxation on income associated with capital formation while failing to broaden the portion of the income base associated with consumption. Put another way, the problem is that we start with a concept called taxable income which is far from comprehensive in that it excludes many forms of true income. We then allow the deduction of pension asset acquisitions and exempt many forms of capital income. The tax base that is left over turns out to be far less than total consumption. Because the tax base is so badly eroded, the marginal tax rates on what remains have to be undesirably high and this creates all sorts of new problems for efficiency and productivity.

The most important component of untaxed income that is used largely for consumption purposes is that associated with transfer payments. Social security is, in turn, the most important transfer payment. The political problems associated with taxing some or all of social security need not be elaborated, but its complete omission from the tax base is impossible to justify logically. Unemployment insurance, now partly taxed, and other transfers are also significant and should be taxed fully. That does not mean that you have to tax poor people. As noted previously, a consumption tax system can be run in a progressive manner and basic exemptions could be quite large. But, unless transfers are included in the concept of income from which net saving is deducted, a large part of consumption will go untaxed and the tax burden imposed on the remainder will have to be raised. Taxing transfers results in further efficiency gains because it would reduce the work disincentives inherent in most transfer programs. Now, when a person has a choice between an untaxed transfer associated with not working and taxable wages, the choice is far more distorted than it need be.

Note that transfers should also be taxed in a comprehensive income tax system.

Gifts and bequests that are not reinvested would also be added to the tax base in a perfect consumption tax system as would all realized capital gains that are not reinvested.

Another problem with our current hybrid system is that it creates all sorts of opportunities for tax arbitrage. Although many types of asset income go untaxed, interest deductions for borrowing are still allowed. It, therefore, pays to borrow to invest in tax free acounts. A tax payer in the 50 percent bracket comes out ahead as long as the interest rate on the debt is less than twice the rate of return on the tax free asset. He or she can significantly increase after-tax income without saving an extra cent. Usually, this will occur subtly and indirectly. For example, imagine a taxpayer contemplating the purchase of an auto. If cash is paid for the auto, the tax payer may not have enough money left over to take full advantage of the new IRA privilege. But if the car is financed with a loan, the taxpayer can have both the car and an IRA without saving any extra money.

More generally, the deduction of interest encourages the addition of both assets and liabilities to balance sheets. Leverage is encouraged and the probability of bankruptcy is increased. In addition, the Treasury loses a great deal of revenue for every extra dollar of saving that is encouraged.

It is clearly foolish to use our tax system to encourage both saving and borrowing. Interest deductions, especially for consumer loans, should be abolished. Ideally that should include the mortgage interest deduction.

But that is about as realistic as advocating the taxation of social security.

Nevertheless, it is hard to advocate continuing the march toward a consumption tax system without doing something about interest deductions. If that problem could be resolved or at least limited in scope by, say, a cap on interest deductions, it would be much safer to move further toward a consumption tax system. A variety of techniques could be used, but my preference would be to expand the limits on pension saving and to allow IRA-type privileges for non-pension saving.

If, contrary to my own view, people decide that the income tax approach is preferable to the consumption tax approach, economic efficiency could be improved greatly by reducing the special exceptions and privileges that riddle our tax system. Most are counterproductive. They complicate the system and greatly distort the allocation of resources. With a more comprehensive tax base marginal tax rates could be lowered greatly and it cannot be emphasized enough that it is high marginal rates which cause inefficiency. The U.S. Treasury's 1977 Blueprints for Tax Reform showed that with a truly comprehensive income tax, 1977 tax revenues could have been maintained and that year's distribution of after-tax income would not be altered significantly using a rate structure with the highest marginal rate equal to 38 percent. A comprehensive consumption tax would require a maximum rate of 40 percent.

How would the corporate income tax fit into a comprehensive income or consumption tax system? It would not. It is hard to justify a separate corporate tax using any theory of taxation. Applying an extra tax to capital invested in an entity solely because of the nature of its legal organization creates productive inefficiency and is inequitable since the owners of the corporation vary greatly in their economic circumstances. There are techniques for integrating corporate and personal income taxation so as to eliminate or reduce the double taxation inherent in the current system. Such integration plans exist in most other Western countries, but partial integration was rejected in this country when proposed twice in the 1970s by the Ford Administration.

In this country we have chosen to mitigate the negative impact of the corporate and other capital taxes on capital formation by providing special incentives for new investment through accelerated depreciation and the investment tax credit on equipment investment. This enables us to continue collecting revenues on old investment. At first sight, this appears to be a clever device for encouraging investment without losing excessive revenues. Unfortunately, we have probably been outwitted by our own cleverness.

There were powerful arguments for significantly reducing the taxation of capital in the 1981 Tax Act. As previously explained, inflation had greatly increased the tax burden on capital. Depreciation was clearly insufficient and had to be enhanced. Unfortunately, the technique chosen has numerous unintended consequences. The 3-5-10 system leaves taxes on capital dependent on inflation and it has different impacts on different types of investment. Consequently, it will result in significant distortions in investment patterns. In particular, debt financed investment now faces a highly negative tax rate in most firms. If interest rates fall and if the 1985 and 1986 steps in depreciation reform are implemented, almost all equipment investment will face negative tax rates and negative tax rates can be just as distorting and inefficient as positive tax rates.

More fundamentally, the strategy of providing excess deductions and credits for new investment only works to reduce long-run tax burdens if firms have tax liabilities on old investments that can be offset immediately. Of course, new firms and firms with recent losses do not have such liabilities. The new safe-harbor leasing rules were created to avoid discriminating against such firms. However, leasing is poorly understood and very unpopular politically. It is unlikely to be with us much longer. But without it, the new depreciation law will lose a significant proportion of its effectiveness and will become even more discriminatory than it is currently.

It is because I see no way out of this political bind that I conclude that we tried to be much too clever in 1981. It is clearly necessary to change our strategy.

I would suggest the following radical solution. Scrap leasing. Scrap ACRS. Scrap the investment tax credit. Scrap the interest deduction on debt. Use the proceeds to allow the immediate expensing of equipment investment and to lower corporate tax rates. Expensing requires some sort of leasing or refundability arrangement to work perfectly, but with no investment tax credit and with a lower corporate tax rate, the degree of discrimination would be lowered greatly compared to what will exist under the current system if we do away with leasing.

There are obvious problems with my plan. While my goal would be for the corporate sector to bear exactly the same average tax burden as it does under the 1981 law, some firms would lose enormously while others would gain enormously depending on the nature of their investments and the extent of their interest bill. In addition, the change in investment rules would apply to non-corporate investment and it would be hard to convey an advantage to the non-corporate sector comparable to the decline in tax rates that I envision for the corporate sector.

In addition, in the short run, my plan increases the tax burden on new investment while lowering the burden on old investment. But this occurs because I am abandoning the current undesirable negative tax rate on new equipment investment and moving to the zero rate implied by expensing. Investment will suffer somewhat as a result, but that which occurs will be allocated much more efficiently and the tax system will be less discrimatory and make more sense than it does currently. Ideally, the remaining corporate tax would be integrated with the income tax, but this is not necessary to improve the system greatly. As an aside it can be noted that ending the deductibilityof interest would reduce the strong incentive for borrowing now inherent in our tax system and so reduce the probability of a recurrence of the current situation where so many firms find themselves in tenuous, and often disastrous, financial straights.

I am not unrealistic enough to believe that my plan could be implemented over night. The end of the interest deduction would be disastrous for many firms. But the 1985 and 1986 steps in ACRS should not be implemented and if possible the savings should be applied to phasing in expensing and to reducing corporate rates. When the economy recovers the investment tax credit can be phased out along with the interest deduction. The savings could be applied to reducing corporate rates. Needless to say, even a phase-in would be difficult because of the differential impact on different firms and industries.

All of the above refers to the structure of our tax system. The main inefficiency afflicting us currently results from the fact that aggregate tax receipts will not be sufficient to cover prospective spending unless we cut programs radically. Concerns over the implied huge future deficits are helping to keep interest rates inordinately high and are washing out a considerable portion of the investment incentives enacted in 1981. Unless something is done quickly to ameliorate the situation, much of the discussion of the details of tax policy appearing above will be beside the point. Good tax law cannot offset the negative impacts of a devastating recession. To turn things around we have to lower interest rates and that means lowering future deficits. Since that cannot be done entirely on the spending side, increased taxes are necessary. Ideally, that would be done through base-broadening measures rather than through rate increases. But the former are harder politically and speed is essential. Therefore bad taxes may be necessary to close an even worse deficit.

Senator Quayle. Mr. Boskin?

Mr. Boskin. Senator, let me apologize for my late arrival. It is a bit ironic in discussing productivity growth that there was a wildcat public transportation strike this morning in Boston that shut down the Boston public transportation system and snarled traffic. I missed my flight. I apologize for being a bit late. It decreased my productivity today. I hope I can catch up in a way that is conducive to your schedule.

Rudy Penner and I have appeared on many panels in testimony, before our fellow economists and before the public. Our views are quite similar. So, let me just quickly recap the points I made in my own testimony, add a few points that Mr. Penner did not refer to, and then say where I agree and where I disagree rather than repeat some of the arguments that he has made orally and in his testimony. Where I agree, I think I will just note that agreement.

First, let me state what I think is the basic fundamental stake we have as a society in our productivity growth rate. Differences of productivity growth of even a half a percentage point or 1 percentage point per year do not sound like a terribly important item against the short term kinds of economic problems we may have. Unfortunately, when compounded over long periods of time, that type of difference in productivity growth tends to have dramatic consequences. Perhaps the easiest way to point that out before referrinq to our own productivity slowdown is that the United Kingdom growing at only 1 percentage point per year less rapidly than we, managed to transform itself from the wealthiest society on earth to a relatively poor member of the Common Market in the space of two to three generations from the end of the last century to the early postwar period in this century.

Our own productivity growth has been on a rather disheartening long-term decline. This goes back well before the current deep recession and well before the oil price increase shocks of the 1973–74 period. The productivity growth decline seems to be dated by most economists in the late 1960's. In long term U.S. history, even accounting for many fluctuations, the Great Depression, various booms like the early postwar period, we managed to increase our rate of productivity by about 2 percentage points per year on average. Again compounded over the space of a generation, that is almost sufficient to double the lifetime incomes of a generation relative to the generation that preceded it. So, Senator, on average our generation is twice as wealthy as our parents' generation. They in turn were on average twice as wealthy as the one that preceded them, our grandparents' generation. Unfortunately, as the short table I have in my testimony reveals, our long term productivity growth has gradually been slowing and has basically been curtailed close to zero since the early 1970's, almost a decade.

In the short run, productivity is procyclical. As we head down in the economy with a recession, productivity growth tends to slow markedly for a variety of reasons, although the course of output and employment are not usually timed totally in sync with gross national product. Usually, when gross national product starts to increase in real terms, it increases before employment heads up. But I want to, for most of what I have to say today, abstract from the short-term problems related to economic fluctations and come back to those in the 3 or 4 minutes at the end of my testimony.

The causes of our long-term productivity growth and subsequent decline in the last decade are well known although their exact contributions are a source of much debate among professional economists, politicians and the public. It is my own opinion that the three most important sources of productivity growth—and I think supported by my own work and that of others—have been capital deepening, equipping our workers with more capital per worker; technological advances, equipping our workers with better, higher quality, newer technology capital; the growth of expenditures on human capital—which as a society we do much more of than most other societies—that is improving the knowledge and skills and techniques embodied in the labor force; and then a variety of other short term aspects including temporary improvements in the allocative efficiency of our capital stock and our labor force, taking advantage of scale economies, and things of that sort.

Underlying all of these things are the determinants of how rapidly we adopt new technology and generate it, how rapidly people are willing and desirous of investing in themselves, how hard they work at their jobs, how willing they are to adopt new technology, our attitudinal and labor relations types of problems, which change very slowly in my opinion over time but can be substantially important. Unfortunately, all of the available statistical studies we have as economists of labor supply relate to how many hours people work. We live in a society where almost everyone is paid by how many hours they work or the amount of time. A very small segment of our labor force is paid on a piecework basis. So, the intensity of work effort is very difficult to measure. There are only anecdotal studies relating to the fact that, as we, as other societies in their own epochs became wealthier, workers decided to take some of that increased wealth out in shorter work weeks and more amenities on the job.

I myself do not think that attitudes and labor relations have changed so drastically in the last decade relative to the sixties and early seventies or the fifties that this can account for a large part of our productivity slowdown. My own opinion is the overwhelming bulk of the slowdown can be traced to a variety of impediments to expand and generate new technology and new investment and to the not widely heralded sharp decline in the efficiency of the use of our capital stock due to energy price increases. That is, we carry our capital stock on the records—the Commerce Department, even in its attempts to improve its measures of our investment in capital, carries our earlier capital stock on the books at book value or that adjusted by some construction price index. In many industries, particularly heavy industry, the energy price increases in 1973-74, and beyond made the existing capital structures and equipment much less efficient in economic terms. Our basic data do not reflect that. That is, we had a once-and-for-all large drop in our effective capital stock for our workers, particularly in those industries.

Second, until the early seventies, we were increasing our rate of investment per worker by about 2.5 percent per year. Starting in the early seventies, the post-World War II baby boom generation moved into the labor force. The sharp increase in the labor force participation of married women meant that the number of workers expanded enormously in the seventies. While one of the great feats of our economy in the seventies was finding employment for almost all of those people, a major problem was that we could not expand our rate of capital formation enough to account for both this substantial loss due to energy price increases that decreased the efficiency of our capital usage and the growing labor force.

So, if we would look today, our capital/labor ratio, the technical term economists use, is much lower than it was a decade ago even though the technical data that is reported by the Commerce Department would suggest that our rate of investment has not slowed down very much.

A second point I would like to make relating to that is that, even when we generate new technology, whether in the public sector or in the private sector, its rate of diffusion to other industries, other companies, other sectors of the economy, the rate at which we embody it in our ability to increase productivity is much slower now than it was, for example, 10 or 15 years ago and is much, much slower than it is in most other countries.

When I was a graduate student—which I used to like to think was not too long ago—it used to be said that a major explanation for our low rate of investment and saving relative to economies like France, Germany, and Japan was that we were so much wealthier than they and that recovering from the ravages of World War II, it was obvious that they were going to have much higher rates of investment to catch up. Well, unfortunately, that kind of argument no longer washes. The average GNP per person, although there are many reasons for distrusting this as an exact measure, is now higher in Germany than it is in the United States. If our current productivity growth rates are as bad as they have been lately, Japan will pass us by in the not-too-distant future.

We should not totally direct our own policy at our foreign competition or at societies we tend to compare ourselves with. But ask yourself why is it the case that investment opportunities for Americans seem not to be as great as they are for those in other societies that have much higher saving rates and much higher rates of investment. Especially in a capital market that sees many capital flows across international boundaries, it is indeed surprising that we are not taking advantage of what world investment opportunities exist. Our rates of expenditures on R. & D. as a government and privately have declined substantially as well.

Our rate of Government investment has basically fallen to close to zero although the current budget and budget plans indicate a shift away from Government consumption spending and transfer payments toward Government investment.

I have been trying to generate a separate capital account for the Government. As you know, Senator, we do not have one at the moment. So, it is very hard to really know what the true deficit on current account is. But our investment in structures, in equipment, in inventories, and the like in the public sector in the Federal Government was certainly less than the depreciation and obsolescence of the Government's capital stock in the late seventies. That is, the way we financed the growth of a variety of other spending programs including transfer payments was not just higher taxes but by running down our Government capital stock.

All of these things, I think, augur particularly perniciously when we take account of this interaction of investment and technical change that because, at least for some types of new technology, they must be embedded in new capital as opposed to costly conversion of old capital or because in the investment process new products and techniques become obvious that would not have been available had we not been doing that investing, that our low investment rate is feeding back to a low rate of technical advancement.

So, where does that leave us? It leaves us with an underlying long-term need, quite aside from the current recession, to have a substantial increase in our rate of investment and our rate of technical change.

I should also add that it is my own belief that Government spending on R. & D. and investment purposes has badly been neglected in recent years. One of the major things that I think has not gotten enough attention in recent budgetary priority shifts is the shift to investment away from spending on goods and services for current consumption.

Next, I think it is important to point out that our own private saving rate, which has been deplorably low for many years, much lower than that in any other society and much lower than most technical analyses would suggest would be desirable once we are out of a recession averaged over normal times, is really a major cause for concern. It is a major cause for concern because, without an increase in our saving rate domestically, we will either have high interest rates in our attempt to expand investment and our investment incentives such as ACRS and a variety of other features of the tax law, the investment credit and the like, either will drive up interest rates rather than produce more investment or we will have to import a progressively larger fraction of foreign capital in order to finance our investment.

I am not in favor of either of those. It is not that I have anything against foreign capital. I think the other purpose of saving besides financing our investment is to give our citizens an accumulation of assets for their retirement, which will help save our social security system several decades hence.

In any event, I believe that the strategy of focusing on investment incentives without sufficient regard to saving incentives, was a mistake. I think that there was an overoptimism as to how much the general personal tax rate cuts would expand private saving. Indeed, a prominent administration official early on suggested that he thought the bulk of the tax cut would be saved rather than spent. I think that is on the order of 10 times as large as the current propensity to save of Americans.

My own view is that the saving rate will respond to lower tax rates but not nearly that large a response. Therefore, in the short run to stimulate investment, to get interest rates down, probably the single most important thing we can do is to provide more capital to capital markets.

I do not believe we can provide more capital to capital markets by increasing the private saving rate quickly by any major tax change in prospect or in contemplation. I believe the only way to supply more capital to capital markets quickly is to decrease Government dissaving, that is, our deficit.

I share with Dr. Penner his concern for the prospective very large deficits, although I think we do have to adjust those for the decline in the value of the previously issued debt due to inflation and adjust it for the course of the business cycle. But, still, they are very, very large in prospect next fiscal year and beyond.

In any event, to start to stimulate investment now, I think we really need to decrease Government dissaving and increase saving, as we come out of the recession to lower interest rates so that these investment incentives can have some impact.

In the long run, however, we need to stimulate our rate of capital formation not just over the next couple of years to try and promote a healthy recovery, but we need as a society during normal times or averaged over economic fluctuations to devote a higher fraction of our potential output to capital formation. The only way we can do that is to redress the continuation of our system of taxation and other types of incentives to borrow, as Dr. Penner put it, to finance consumption.

We need to consume slightly less—once we come out of the recession—for many years, to increase our rate of capital formation for many years, before we will see a major long-term expansion such as was witnessed in Germany, Japan, et cetera, when they, at a time when their standard of living was much lower than ours is now, were able to curtail consumption in order to promote such investment.

Among the many ways one could go about doing that, as Dr. Penner indicated, would be to continue the piecemeal movement we have had toward a personal expenditure or consumption tax and to deal with some of the specifics that he mentioned in terms of closing the ability to tax arbitrage by adding simultaneously to your assets and liabilities without any significant increase in real net saving.

Virtually all economists, I believe, who have studied this problem would conclude that a personal expenditure tax likely would be not only more efficient but also potentially more equitable than our current individual income tax. I believe there is growing consensus among tax lawyers and professional economists that such a tax can be and should be gradually phased in over time.

I would like to support Dr. Penner's testimony in that regard.

This might involve integration of the corporate and personal tax. If not, it might move to expensing plus some changes in interest deductibility. It would also mean something like a universal IRA account without limits and without substantial penalties for withdrawal at any point in time, things of this sort.

The Treasury has over the last several years issued blueprints for transiting to such a tax. Hopefully, once we are out of this recession, we can reconsider that possibility.

In terms of our ability to increase our rate of innovation and technical change, available statistical evidence suggests that, while it looks like there is a positive relation between R. & D. spending and our rate of productivity growth, there are many links in that chain; and they are not always directly obvious. My own personal viewpoint is to take something of a social portfolio view that, when we have a society with many risks being taken in the private sector, many new techniques being tried out, many explorations for new products and new techniques, a certain percentage of them will hit the mark. The small firms of today above garages will become larger firms in the future and the Apple computers of the 1990's or the Hewlett Packards and IBM's of the 1990's.

I believe that we need to continue to encourage such activity. I also believe that Government spending on basic research provides a variety of spinoffs that promote such activity. I regret the trends in recent years for reduced Government spending on research for basic knowledge in the sciences and elsewhere.

My conclusion then is certainly that as a society we need most desperately to develop a strategy for restoring our historical productivity growth rate. If not, our society will not see dramatic increases in its standard of living over long periods of time. Our children will be no wealthier than we are. Those who have not yet made it on the economic ladder—minorities, some groups of women and others—will find all the pressure that a stagnant economy provides for them to move up and develop and fulfill their economic expectations and hopes much harder to fulfill than in a growing economy. We will also see many of the groups, countries, and competitors we deal with grow progressively more wealthy than we. That may be a conscious choice we want to make as a society. It is my own view that in the pursuit of other goals we have wound up through a variety of willy-nilly policies pursuing the exact opposite. We have wound up pursuing a policy that has led to stagnation relative to our potential.

I certainly believe that structural reforms in our tax system and a consensus that the long-term stake in productivity growth concerns the future standard of living of all Americans suggests to me that this is a very high priority issue as we come out of the recession.

In the short term, I think there is basically no serious alternative to reducing the outyear deficits, most preferably by finding further spending cuts as target effective and cost conscious as possible in order to allow what investment incentives there are to generate extra investment via lower interest rates. Barring that, I see a very sluggish recovery, and I do not see these extra investment incentives working very well in the long run either.

Thank you very much.

Senator QUAYLE. Thank you very much, Mr. Boskin.

Without objection, your prepared statement will be inserted.

[The prepared statement of Mr. Boskin follows:]

Testimony

by

Michael J. Boskin
Professor of Economics
Stanford University

to the

United States Senate Subcommittee on Employment and Productivity

April 16, 1982

1. Introduction

There are many reasons to be concerned about the rate of productivity growth in an economy. The recent actual declines in output per hour of all persons in both the private business sector and the non-farm business sector in the United States are substantial causes for concern. However, I wish to confine my remarks today to long-term productivity growth and abstract from other important dimensions of productivity, such as its variation over the course of economic fluctuations and its short-term relation to employment. With this in mind, I wish to develop an important theme: since the overwhelming bulk of factor input in the production of output in the United States is labor output, the growth of labor productivity is the primary source of improved living standards over long periods of time. To put this simple notion in starker relief, consider the fact that even small differences in annual percentage growth rates of productivity over relatively modest, by historical standards, periods of time can drastically alter the nature of an economy and society. For example, the United Kingdom, with a productivity growth rate about 1 percentage point less than that of the United States, France, and Germany managed to transform itself from the wealthiest society on earth toward the end of the 19th Century to a relatively poor member of the Common Market today. While extremely difficult conceptual issues of comparisons arise, our very low productivity growth rates over the last 15 years compared to other relatively developed economies have wound up creating a situation where the average income per capita in France and Germany now exceeds that in the United States. Simply put, the very nature of our society and economy as it evolves over the next few decades will be substantially determined by the rate of productivity growth.

The purpose of this brief testimony is to report some important potential links between the nature of our tax system and the potential determinants of productivity growth over long periods of time and to suggest some potential policy reforms which might assist us in restoring a steady rate of increase in labor productivity.

Before turning to this discussion, I wish briefly to document the decline in productivity and some apparent or alleged causes for this decline, as well as the potential determinants of our historic long-term rate of productivity growth. I will also briefly mention some measurement problems in the analysis of productivity.

2. The Productivity Decline

Numerous studies of productivity growth, focusing on different sectors of the economy, or using slightly different measures of output and input can be derived. Table 1 reports one archetypical measure: the estimates of average annual rates of change of output per worker hour between peak years in business cycles; this is designed to at least in part to extrapolate from the cyclical variation in productivity generally

Table 1

Average Annual Increase in Labor Productivity, Private Business Sector, Postwar Period Between Cycle Peaks

1948-53	3.6%
1953-57	2.4
1957-60	2.4
1960-69	3.1
1969-73	2.3
1973-79	0.6

experienced both in the United States and in other economies.

The most striking feature of the Table is the enormous decline in productivity since the early 1970's. Indeed, many economists, myself included, would actually date the beginning of the long-term productivity growth slowdown in the late 1960's. In any event, it is clear that there are many potential determinants of our long-term productivity growth rate of 2 to 2.5% as well as many reasons why such a rate temporarily expanded or contracted, even abstracting from the short-run vagaries of economic fluctuations.

However, this rapid decline in our rate of real economic growth in recent years, when compared to our historical experience and to the recent experience of other countries no better able to take advantage of growth opportunities than we, suggests that restoration of economic growth to something like its historic levels should and will be the major economic policy goal in the years ahead. Is the United States capable of reverting to its historical growth? Or have we reached a stage where our economy will continue to stagnate? Are developed and imposed restraints on growth so great as to prevent a general increase in the overall standard of living?

We do not have careful and precise and well-agreed upon answers to these questions. There are several basic ways in which an economy can improve its labor productivity and therefore real incomes per person. First, the available labor force can be made more productive by providing them with more capital per worker. Over a long period, the average annual increase in the capital/labor ratio in the United States economy was approximately a 2.5%; since the early 1970's there has been no increase whatsoever in this ratio. This implies not only that workers are not getting more capital with which to work; it also implies that production methods are changing very slowly. The enormous growth of our labor force, due to the combined impact of the post-World War II baby boom generation moving into the labor force for the first time and the dramatic rise in the labor force participation rates of married women, created a tremendous problem for our economy: finding increased employment for a dramatically larger fraction of our adult population and simultaneously finding the capital to equip them to produce goods and services efficiently and competitively. Worse yet, a variety of scholars have concluded that even these numbers dramatically understate the extent of the decline in so-called capital-deepening. Because of the dramatic rise in energy prices since 1973, a substantial fraction of the U.S. capital stock was rendered obsolete in the economic sense of being inefficient given the new relative prices of energy, capital, and labor. This is especially true in heavy manufacturing industries. Therefore, policies to increase our rate of capital formation have assumed center stage in the economic policy process.

The rate of investment in the United States economy has been much lower than that in Western Europe and Japan for several decades. When I was a student, it used to be argued that this was primarily due to those societies rebuilding after the ravages of World War II and starting from a much lower base of real income. While not much was said about the enormous sacrifice of consumption necessary for those high investment rates starting from a standard of living far below that of the United States, it is no longer plausible to argue that this is a major reason for international differences in investment: France and Germany now have an average income larger than the United States and Japan is rapidly gaining. Further, there is little reason to believe that investment opportunities noticed by those in other societies are not also available to us.

The second major way to improve labor productivity is to provide them with better quality capital. While our understanding of technical change is somewhat limited, many historical episodes from the reformation of crop rotation systems in agriculture, including important transportation advances and most recently the explosion of high-speed electronic technology attest to the importance that innovation has played in economic growth. Two important issues with respect to technical change and their relationship to investment suggest that a society with a very low rate of investment may suffer substantial long-term growth slowdowns. First, is the extent to which the investment process itself leads to "learning-by-doing" and hence, opens up opportunities for new types of investments, further lowers production costs, and frees resources for other purposes. The second is the extent to which new technology is embodied in new capital as opposed to converting old. Since the U.S. investment rate is only half that of the Japanese and only two-thirds of that of Western Europe, even when we generate new technology, they embody it in their capital stock much more rapidly than do we.

The third major method to promote economic growth involves improving the knowledge and skills of the labor force directly, so-called human capital. Investment by workers in an attempt to increase their future earnings, whether in the form of higher education or health, nutrition, mobility and experience and training-on-the-job are undoubtedly quite important in the overall growth process. However, there are much greater difficulties in measuring investment in human capital and its rate of return than there are for the corresponding, also difficult, problems in measuring investment in tangible capital and its return. Overall, it has recently been suggested that investment in human capital is perhaps as large as the investment in ordinary capital. Certainly we spend a much higher fraction of our income on advanced education than do most other societies. Also, we invest much more heavily in housing, although the Economic Recovery Act of 1981 contains tax provisions which will decrease the relative tax advantages of investment in housing relative to investment in plant and equipment.

Other factors may influence the economic growth for short periods. For example, improvements in resource allocation toward more efficient uses can increase the level of income for a while, and hence, accelerate the growth rate temporarily. Such advances can not increase the rate of economic progress indefinitely, because opportunities to improve allocation of resources will eventually be exhausted. The most widely quoted growth accounting study is that of Denison. He attributes about half of an adjusted growth rate of 2.6% to advances in knowledge and about half to changes of capital and land to person employed, to improved resource allocation and to the economies of scale of larger markets.

In addition to technological advance embodied in Denison's residual, organizational, managerial, and social innovations can be important over long periods of time; for example, changes in labor/management relations. In this attempt to decompose growth accounting, it is important to realize the important interrelationships among the various factors that cannot be easily be quantified. For example, the measurement of labor quality is important. If embodiment of technology is important, the contribution of technology to productivity growth depends upon the investment rate.

Lying behind our rate of productivity growth determinants such as capital-deepening and advances in technology are the fundamental incentives and attitudes of population. Until the Economic Recovery Act of 1981, virtually all economists would characterize our tax system, for example, as having a substantial pro-spending and anti-saving and investment bias. We also have developed a substantial set of expectations concerning living styles in the United States over a span of time: for example, the desire of households to own their own home rather than rent an apartment, has interacted with our incentive structure to create a situation where the United States has a much larger fraction of its capital stock invested in housing than do other advanced economies.

Many items do not enter into productivity calculations and it may well be that workers, individually or in groups, prefer to take out some of their potential increase in the standard of living via working less diligently on the job or being provided with nicer amenities. Since virtually all available studies of labor supply are unable to differentiate the intensity of work effort from the amount of time at work, the factors that influence work effort per unit of time spent are not very well understood. As we become a wealthier society, it seems reasonable that individuals will choose a shorter work week, increased leisure time activities, etc., and that this may also include certain less demanding characteristics in jobs. If we had the appropriate information, we could approximate the value of these increased amenities and include that in our measure of real income in trying to analyse the extent to which living standards have changed. The only attempts to do so have adjusted for the average size of the work week, which has declined substantially since World War II, but not for the "quality of the work experience". For example, as marginal tax rates increased on the bulk of the labor force through the last two decades' interaction of rising tax rates and inflation, non-taxable amenities became relatively more desirable. Further, in the short-run, there may be substantial resistance to technological changes that threaten the short-term employment or nature of work in specific industries. Compare how decisions about adopting new technology are alleged to be made in certain other economies such as Japan, including some percolating up of these suggestions and ideas from workers, rather than imposition from a detached management. Further, there is a substantial anecdotal argument that American firms managers have much shorter time horizons than do those in other societies, and hence, are unwilling to engage in long-term risky projects with substantial potential payoffs in terms of increased productivity and lower costs, because these would not show up rapidly on the firm's profit and loss statement.

It is also alleged that the explosion of government regulation, particularly the new social regulation, have substantially reduced productivity. For example, pollution control and worker safety regulation. While these types of regulations are designed to promote benefits which are in principle quantifiable -- the value of cleaner air or greater safety -- most attempts to do so are in their infancy. What is important to note, is that while government regulation may have been a non-trivial contributor to the decline in productivity growth, its direct effect is generally not thought to be the major explanation of the productivity slowdown. The indirect effect in stifling investment and innovation may be more important.

While we cannot be certain about the precise causes about the recent decline in our productivity growth, targets ranging from Thurow's sectoral shifts in the economy toward services to Siegel's emphasis on the reduction of the rate of capital-deepening to Denison's declines in the advances of knowledge, a general consensus exists that the following have been important contributors:

1. The displacement of private economic activity by government economic activity in the sense that the growth of government economic activity in the last few years was primarily on transfer payments, even at the expense of a decline in government research development expenditures direct government investment. Indeed, I have elsewhere estimated that the federal government's rate of investment was not sufficient to cover the rate of depreciation and obsolescence of its capital stock.

2. The changing age, experience, and occupational mix of the labor force.

3. The shift in output away from manufacturing towards services.

4. The growth of government regulatory policies.

5. The high and rising marginal tax rates on the returns to saving and investment which led to a declining rate of private capital formation, capital-deepening and innovative activity.

Thus, monetary and tax policies substantially alter the scenario with respect to each of these potential determinants of productivity growth.

Tax policies influence the allocation of resources between the public and private sector; budetary priorities influence the allocation of the government budget between investment, consumption, and transfer payments, as well as R&D expenditures. The tax system affects private decisions to invest and save versus to consume; also, the share of resources devoted to innovative activity. The recent changes in the tax law which substantially decreased the effective marginal tax rates on different types of new investment through the accelerated cost-recovery system (ACRS) were designed to provide a substantial stimulus to investment. By increasing the demand for new capital, they also closed the gap in the tax advantage in the investment in housing. Other things being equal, their long-term impact should be to increase investment in plant and equipment, as well as our overall rate of investment. However, in the context of a very tight monetary policy and very large budget deficits, the short-term impact is probably at best to raise interest rates. While some features of the tax law have prevented the saving rate from declining still further and hold out the prospect for eventual increases in the rate of private saving, partly from lower marginal tax rates than otherwise would have come and partly from structural features such as the liberalization of Individual Retirement Accounts, the increase in private saving will not be nearly sufficient to finance the increased investment demand without a rise in interest rates or substantial importation of foreign capital. Further, the acceleration of the saving response is likely to take some substantial period of time; the greatest short-term feature of the tax code will result in reallocation of existing assets.

With this in mind, how can we generate extra saving in the U.S. economy? There are two logical places to start, one short-term, the other longer-term. The only real hope for a substantial increase in our saving rate in the short-run is for a substantial decrease in the rate of government dissaving, i.e., a decrease in federal government borrowing to finance increased spending. A modest impetus could also come from a reorientation of spending priorities toward investment in tangible capital and in expanding rather than contracting R&D expenditures. While I do not suggest that a reduction in the deficit via reduced government spending or tax increases is desirable in the context of the current recession, the prospect of very large government deficits is well beyond the decline of the real value of the previously issued national debt well into what should be normally a recovery period does not augur well for the supply of capital furnished to interest sensitive potential investors and innovators.

I have elsewhere estimated that it would be desirable for the United States to increase its rate of saving and investment by at least 5 percentage points.[1] Even once we come out of the recession, this will imply major structural changes in the relation between government and the private sector in the U.S. economy, the composition of the federal government budget, and a reduction in private consumption. The latter is necessary to free up further resources for increasing saving and investment. This will make it possible to expand productivity and future living standards in the United States. Perhaps the best way to shift a modest amount of resources in the private sector from consumption toward saving would be to restructure our tax system, once we are out of the recession, to a system based primarily on expenditure, rather than on income. While adoption of any new tax device is probably undesirable, the current personal income tax could and should be changed to a personal expenditure via substantial liberalization of the amount, and substantial elimination of the restriction on "reinvestment accounts" such as Individual Retirement Accounts. The substantial increase in the return to such saving activity will increase private saving substantially and add further to the pool of funds available to finance our desperately needed capital formation and expanded innovation.

Specific structural features designed to aid specific industries, or regions of the country, should be resisted. Except for short-term relocation assistance for workers in industries which over a long period of time ought to be contracting in the United States to allow us to take advantage of our international comparative advantage, we should be very chary of any attempt to target specific tax incentives in the form of an industry specific policy. The ability of the government to separate winners from losers, or tomorrow's high productivity growth industries relative to millions of private investors working through thousands of financial intermediaries seem remote.

---

[1] See M. Boskin, "Some Issues in Supply-Side Economics," in K. Brunner and A. Meltzer, eds., Supply Shocks, Incentives and National Wealth, Carnegie-Rochester Conference on Public Policy, 1981.

3. Conclusion

There are many types of government policies which affect our long-term rate of productivity growth. Whether the direct research and development activities of various levels of government, the regulatory activities which influence potential costs, returns and risks involved in engaging in investment and technological change, monetary policy which may substantially effect inflation and therefore the cost of capital and the risk involved in long-term investment, various special features of our tax and other laws also influence investment demand, R&D expenditures, and our ultimate long-term growth potential. Increasing the supply of capital available for investment in order to increase our rate of capital-deepening; and expanding the share of our resources devoted to capital are the highest priority items in long-term growth policy today. If we are going to begin the long and arduous process of restoring anything like our long-term productivity growth, we must be willing as a society to make fundamental changes in our budgetary and tax policies and accept for a non-trivial length of time a slightly lower standard of consumption in order to increase our rate of capital formation. Barring the individual and political will to do so, will lead to a situation where our standard of living continues to rise at a very much slower rate than that in most other societies, together with all of the economic and social upheavals and distress which such long-term stagnant productivity growth implies.

Senator Quayle. Mr. Boskin and Mr. Shapiro, you both talked about the fact that we need to improve our data collection. Mr. Boskin, you talked about productivity data. Mr. Shapiro, you talked about data which will help better understanding of the dynamics of competition.

What should we be doing? Should these figures be compiled by the Department of Labor? Can you be more specific on what you are looking for?

Mr. Boskin. I certainly can, sir. I would be delighted to. I think that the Commerce Department has made some noble attempts to improve their capital accounting, but the budget of the U.S. Government would not pass the accounting standards under the Securities and Exchange Commission if the Federal Government was a publicly traded corporation. The Federal Government does not have a capital account. We do not know the value of our capital; we cannot tell you the value of our liabilities. We do all sorts of other things I will not get into elaborate detail on here. One thing we require publicly traded private corporations to do, for example, is to adjust their liabilities for inflation. That means our deficit should have subtracted off from it the value of inflation times the previously issued national debt prior to that year.

We also have lots of other rather crazy things we do in our capital accounting. We do not have very good measures of the capital we own. We certainly do not have measures of the market value of it. We have measures of its historic and book cost. Then we make some rather ad hoc adjustments to it by the Commerce Department but not in our official budget. We do not, for example, have any sensible ways of dealing with loan guarantees. We do not have a bad debt reserve. We have no notion of whether that bad debt reserve should be larger or smaller than that commonly used in the private sector. Those loans are probably less likely to default because the Government is behind them, but why did the Government have to make them in the first place: probably because those people had a hard time getting credit in the private sector.

All those kinds of considerations suggest to me that, even on the most simple level the budget of the United States is becoming a decreasingly comprehensive document as a report, an account in retrospect. Forget about difficulties of forecasting. But, if you were trying to ask what happened in 1979 or 1980 or 1981, the budget of the United States is not a very complete document. The outlays and revenues are not the totals that actually occurred. The deficit has very little relation to the difference between real net spending and real net outlays of the Federal government. One would have to make a large number of adjustments to that number to have a sensible notion of what the Government's real change in net worth was. A simple example is we have never really taken account of the enormous capital gains the Government has had on its land and mineral rights. That is on the positive side of our balance sheet of the Government. And there is the decline in the value of our financial liabilities because of inflation. Those bonds issued in 1980 declined in value in the last couple of years because of inflation, but we do not adjust for that.

On the other side, we do not have a separate capital account in the budget. Commerce Department has what I consider to be horrendous calculations of the rate of depreciation and obsolescence of the Government capital stock.

I am not an expert on military depreciation, but I know a variety of people in key policy positions in the Pentagon in this and the previous administration who are deeply concerned about that rate of depreciation and obsolescence. It is not just in the military capital stock but also in the buildings, the equipment, the inventories owned by the Federal Government and the State and local government. The market value of much of that has declined for a variety of reasons. Yet, we carry it at book value. The Commerce Department adjusts it. It never shows up on our balance sheets.

In order to improve the notion of how the Government impacts financial markets, how the Government impacts the rate of Government investment, we need beetter information; for example, I would like to think that many Government investments are well thought out, that the agencies have done the appropriate cost-benefit analyses at least approximately correctly and that what Government investment is proposed is likely to have as high a productivity rate in terms of increasing our national well-being as corresponding private investment it may displace. But we do not know what the rate of Government investment is.

Senator QUAYLE. Mr. Shapiro?

Mr. SHAPIRO. As I remarked, in trying to assess the impact of particular antitrust policies or indeed of antitrust as a whole, on economic performance or any parameter of economic performance, there are some very tough methodological problems that we ought to recognize at the outset. First is that antitrust operates principally through deterrence. It is intended to operate that way.

It is very hard to get data on how much conduct was actually deterred, how many bad things did not occur, and, on the other side of the ledger, how much innovation, how much productivity improvement, how much investment in market share and so on did not occur for fear of antitrust consequences. That is one problem.

The second problem is that you are always trying to assess the consequence of a particular policy or intervention as against some alternative. Unfortunately, it is virtually impossible to run controlled experiments on stuff like that. If you prohibit a merger, you cannot say what the consequence of that merger would have been had you permitted it. You only get one shot, and running that comparison is virtually impossible. You can try to run matched pair studies and so on, but it is not easy to do. It is not clear that we know enough to match pairs very effectively.

Finally and perhaps most significantly, it turns out that, if you really want to understand competitive behavior, you have to make a substantial amendment in the classical model of perfect competition. It is assumed by that model that, beyond some minimal scale, all competitors have approximately the same costs. That turns out not to be true. But collecting meaningful cost data from corporations creates some serious problems. First of all, that is highly confidential information, and companies are understandably reluctant to disclose it. Second, the accounting system by which we keep score on costs is subject to serious criticism for some of the reasons that Mr. Boskin has alluded to but also others relating to the difference between financial accounting on the one hand, and actual cash cost measurement on the other hand: the problems of allocations, of shared expenses, of overheads, the problems of how to treat capital costs, and so on, in order to determine the actual unit cash costs of production, which is a key issue in competitive dynamics. Those problems are very hard to deal with.

Now, what can be done about it?

It turns out that the most useful data that we have collected over the last decade on competitive dynamics does not come from the Government or any other public source. It comes from the proliferation of a new kind of institution over the last 10 or 20 years, and that is the private consulting firm. Firms such as the Boston Consulting Group, which has played a crucial role in the reexamination of competition theory, get access to an awful lot of company's data. They have an opportunity to go into it and wallow in it deeply and then to recast it in economic terms as opposed to accounting terms.

Some of the materials which have been published by BCG and by the Strategic Planning Institute provide the best source of information we currently have as to the way competition actually operates in many varied kinds of markets. I do not know of any way to encourage those groups to publish more. Part of what they collect is confidential to their clients. I would imagine, also, that these firms may be reluctant to publish everything they learn because consulting is a competitive business. To the extent they share their information and findings they may lose some of their competitive advantage. Nonetheless, I would suggest that is probably the most promising source of data to help us understand how competition really works and to develop more effective public policy.

Senator **Quayle**. Mr. Penner, I certainly agree with your recommendation that the reduction of the deficits is of great urgency. I suppose somebody would say that all taxes are bad taxes; there is no such thing as a good tax; so, whatever the Congress may do to expand that revenue base, it will be along the lines of bad taxes.

I wonder if you might comment for this committee beyond the idea of moving toward a progressive consumption tax, which I certainly support from a philosophical basis, and beyond the impact of the deficits, if you could comment on the relationship of the continuation of high interest rates, say at 16 or 17 percent, on productivity itself. What kind of an effect does this have on productivity in 1982 and in the outyears? Is there one?

Mr. **Penner**. I think there is very certainly one, but I do not think that the economists have reached a consensus on what policy problem is to blame for what portion of the extraordinarily high real interest rates that we have today. The effects of those high real interest rates vary from one kind of investment to another. I have done some very crude calculations on what I call the typical equipment investment and have concluded that the benefits that we conveyed with the ACRS legislation of last year are washed out by a 2-percentage point increase in the interest rate. That is a very crude calculation. Other people might come to a slightly different answer using somewhat different assumptions. But I think that is a pretty good idea of the order of magnitude. Unfortunately, long- and middle-term interest rates are now roughly 150 basis points above what they were around the end of 1980. So, it is my conclusion that we have washed out a very high proportion of the benefits that we gave last year.

It goes beyond that, I think. Perhaps the main effect of the prospects of rising deficits is not so much on investment directly but, rather, on the great uncertainty it causes. Everybody looks at it. Everybody perceives it to be a very serious problem. The businessman right now does not have much of a clue as to how we are going to solve that problem. He or she does not know what kind of taxes are likely to be increased. One of the grave uncertainties is whether the Federal Reserve System can continue an anti-inflationary policy while these enormous amounts of debt are coming out onto the marketplace.

While middle- and long-term interest rates may only be 150 basis points or so above what they were at the end of 1980, I think you have an additional problem. The investor, before he will contemplate an investment, demands a much higher risk premium than he did a year or so ago. That adds to the interest rate problem. That is to say he needs a higher rate of return relative to interest rates before an investment will look good.

I think it is causing all sorts of problems that go beyond even just the effects on the real interest rate directly.

Senator **Quayle**. When you speak of expanding the revenue base to get the deficits down you have come to this conclusion because you have been around here for a while that it is going to be on the tax side. Do you have any specific taxes that you are talking about that could get through Congress besides elimination of the mortgage deduction and things like that that you so eloquently articulate but have no real chance of getting through?

Mr. **Penner**. I think that is a very difficult problem. There are basically two approaches that one can take to this situation.

One can go the base raising route, which, from the point of view of good tax policy, is a proper way to go. One can make up a very long list of base broadening measures, some of which would be both efficient and equitable, which could raise a very substantial amount of money, maybe as much as $50 billion. The problem is that it tends to be a list where each item raises you $2, $3, $4 billion. Each item involves a huge political struggle. Though you might win on some of them, it is pretty clear that it would take a very long time. We do not have a long time. So, I have come to the conclusion that, unfortunately, to raise the sort of revenues that we will have to raise, we will probably have to raise marginal tax rates as well. I would rather not do it, but that does imply to me considering things like doing away with the third step of the personal tax cut that is now scheduled for 1983.

I would like to avoid that sort of thing if we could. But, frankly, I see no way around it. It could, of course, take the form of some kind of surtax. Frankly, I think that one of the best things that we did in 1981 from the point of view of economic efficiency without harming equity a great deal was to lower the extraordinarily high marginal rates we had on so-called unearned income. The rates used to go up to 70 percent. We lowered that to a maximum of 50 percent.

If you just eliminated the third step of the personal tax cut, that accomplishment would remain intact. As soon as you start talking about surtaxes or, in my view, what is even worse, surtaxes only on income above some level, whether it be $35,000 or $40,000, you are starting to undo that accomplishment. It would not be a large undoing quantitatively, but I am concerned about the philosophical direction in which that leads us.

Again, my concern over the deficit is sufficient that I suppose I would even swallow that sort of tax increase under current circumstances.

Senator **Quayle**. Let me ask the members of the panel one final question and solicit a brief response because we do have another panel of three. Mr. Penner said that we are moving toward a progressive consumption tax step by step. He did not recommend any kind of a radical proposal. Let me throw out a radical proposal just to get a quick response from each of you. That is along the lines that everyone talks about, tax simplification, making the tax system much more understandable and easier to deal with so we do not have to deal with all those particular special interest groups that you talk about, the political fight to eliminate any kind of a tax deduction or tax credit or what not.

That would be simply this, in a rough manner. You would have a flat tax of 18 percent beginning approximately at $18,000 and then have a 25 percent beginning at $70,000 and over. On the corporate side you would retain some sort of ACRS but effectively eliminate other tax deductions but cut the corporate tax rate in half.

As an end result along those lines, do you have any quick responses to that kind of a philosophy or eventual approach to tax reform probably in the year 2000?

Mr. **Penner**. It has enormous appeal conceptually from both the efficiency and equity point of view. I think, however, that we economists have been deficient in not studying enough the transition problems involved in such a move. We have not done a good job of developing techniques for handling those transition problems. A major transition problem results from the fact that there would be enormous capital gains and losses throughout the economy because you would be suddenly taxing some sorts of assets more heavily and other sorts of assets much more lightly. I think most people would perceive the big windfall gains and losses to be inequitable.

As I said, we have not done a good job of designing approaches to that problem. I have given it some thought, but I have not solved it to my satisfaction.

Senator **Quayle**. Thank you. Mr. Shapiro, do you have any quick thoughts?

Mr. **Shapiro**. As a nonexpert in the field, on April 16, I would be happy for anything that promises simplification.

Senator **Quayle**. Mr. Boskin?

Mr. **Boskin**. I think there is enormous appeal. I think Mr. Penner correctly points out that we have to be very careful about the windfall gains and losses. I am a little less pessimistic than Rudy is about the possibility for phasing such a thing in. Some of the transition problems have been studied in the context of transiting to a consumption tax, which has some of the same problems, not as severe; so, I think there is some possibility. I think the idea of phasing that in over a period of time or having a grace period and announcing that, as of a certain future date, these were going to be the rates so assets with shorter lives would not have dramatic changes could attenuate the windfall gains and losses somewhat.

I think base broadening with very much lower rates and without the enormous effort we go to and enormous effort the private sector goes to to define certain categories or uses of income or expenditure or saving and the like would dramatically increase the efficiency with which we allocated resources in the economy. I think the major obstacle to your proposal is we have not done a very good job of informing people how little of society's income maintenance, income redistribution, and concern for the general overal equality in society remains in the tax system because the overwhelming bulk of that is now done by a very large transfer payment system which accounts for most of Federal outlays net of interest on the debt.

I therefore find enormous political and practical and economic appeal in the general idea of that.

Senator **Quayle**. Gentlemen, thank you very much. Next is a panel consisting of Mr. Rose, Mr. Campbell, and Mr. Staats. We will take a short recess now.

[Recess taken.]

Senator **Quayle**. The committee will resume. Mr. Rose?

Mr. **Rose**. Mr. Chairman, I have submitted prepared remarks. I will try to summarize those remarks this morning.

STATEMENTS OF MICHAEL D. ROSE, PRESIDENT AND CHIEF EXECUTIVE OFFICER, HOLIDAY INNS, INC.; ALAN K. CAMPBELL, EXECUTIVE VICE PRESIDENT, MANAGEMENT AND PUBLIC AFFAIRS, ARA SERVICES, INC.; AND ELMER B. STAATS

Mr. **Rose**. Mr. Chairman, the increasingly competitive international context of the American economy requires that we become much more sophisticated in our understanding of economic performance and productivity. It requires that we recognize some dramatic shifts in the makeup of our domestic economy. It requires that we be keenly aware of the impact of public policy on competitiveness of U.S. businesses. In order to do so, I believe that we must revise our thinking. We must begin to challenge our assumptions. We must be willing to do some thoughtful, long-range planning in Government as well as in industry.

To begin, I would submit that there are major flaws in our standard definition of productivity. Productivity is most often defined as the ratio of dollars of output to hours of labor input. But defining productivity simply in terms of dollars per labor hour really tells us next to nothing about the true productivity of labor.

By way of example, fluctuations in price create nominal changes in productivity which do not reflect any real changes in the efficiency of the American workplace. We do not believe, for example, that a wheat farmer using the same production resources and techniques is far less productive this year than last year simply because the price of wheat has dropped.

In addition, many other changes in the quality of production occur in areas external to the marketplace which create illusory declines in productivity simply because costs are measured while benefits are not. The compulsory installation of seat belts, for example, credited with saving many lives, falls on the negative side of our productivity formula.

I think, more importantly, conventional measures of productivity fail to take into account the quality of the output, which has become a very real concern in light of the nature of foreign competition. Japan, it would appear, has been producing better cars not just more cars, more efficiently.

Productivity growth really means achieving more and better output for each hour spent at work. Increased productivity does not simply mean working harder or faster but accepting technical and organizational changes that enhance the quality of the work.

The very nature of our economic reality has changed dramatically over the past two decades. Our greatest challenge lies in recognizing that change and adapting to the change. First, we are operating in an increasingly competitive world economy. At the same time, the makeup of our domestic economy is shifting. We are no longer an economy dominated by manufacturing. Services now account for the major share of the gross national product. That share is steadily growing. It is estimated that only 16 percent of America's workers actually produce a tangible good.

Society's goals are shifting. Concern with the quality of life has led to expanded government regulation, regulation designed to protect everyone from the consumer to the snail darter. Industry and ultimately the consumer have been forced to carry the burden of those costs. So, too, has this concern for the quality of life changed the nature of our labor force. The American worker is increasingly concerned with self-fulfillment, participation in decisionmaking, and job flexibility.

How can we adapt to these new economic realities? Industry's major challenge lies in finding ways to manage people and adapt the workplace to new technologies. We can no longer assume that technology alone is the only answer to improving labor productivity. The forgotten element in the productivity formula has been people. Innovative managers are asking questions like how do we get labor more involved in the management process, how do we create an atmosphere of job security, how do we establish a cooperative rather than an adversarial relationship between management and labor.

Many of the productivity advances of the decade ahead should in fact come from the labor-intensive service sector. However, to date, legislators and analysts alike seem to interpret productivity as an issue relevant only to the manufacturing sector. We cannot continue to ignore the service sector and expect American economic performance to improve.

Government retains a strangely slanted approach to productivity issues. For example, under the new tax legislation which was enacted last year, tax credits would be available for technological research and development aimed at, say, developing a new kind of microwave oven for a restaurant but not for behavioral and organizational research aimed at improving the efficiency and output of restaurant service. The Federal Government continues to fund research in the physical sciences but in recent years has drastically reduced its support of behavioral and social science research. Such research is basic not only to innovation and productivity improvement in services but even to the successful production and application of physical technology.

We believe a more balanced approach to research and development would be appropriate.

Government policy should involve other key objectives. First, we cannot ignore the fact that Government has contributed to the productivity problem. Murray Weidenbaum, Chairman of the Council of Economic Advisers, estimates that for every dollar Congress appropriates for regulation it imposes $20 in costs upon the private sector. A handful of widely circulated studies place the cost to industry of compliance with Federal regulations at anywhere from $60 to $130 billion per year.

Where regulation is irrational or obsolete, we must continue the trend toward deregulation. Where regulation is necessary, we must make every effort to streamline reporting requirements. Uniformity and consistency should be rules of thumb for the acceptance of any new regulation, and special care should be taken in introducing any legislation that serves a function that the court system may already provide. Our judicial system offers a far less expensive monitor of compliance than do our regulatory agencies. Regulation inevitably burdens the already-compliant majority in an effort to seek out the offending minority.

Another top priority for both industry and Government should be an effort to reverse the trend toward short-range planning. Critics of American business are almost unanimous in the view that a key element of the productivity dilemma is the lack of long-range strategic planning in American industry and in American Government. American business is too often held hostage to the rapid rate of return, quarterly report tyranny of the financial markets while the Government is increasingly dominated by short-range, special interest, media pressured demands of the next election.

Government could start by reducing the climate of uncertainty which currently surrounds economic decisionmaking. I believe a perfect example of that is the current debate surrounding the Economic Recovery Act. Last October the Government announced a package of tax reductions and tax incentives. Even as we are here today, this debate rages. Congress is talking about repealing key elements of that package. How can management make long-range decisions when Government refuses to chart a course and stay on it? Our political leaders must have the courage to recognize that it will take more than 6 short months to reverse 50 years of economic disincentives from Government, regardless of whether an election looms on the horizon in November or not.

It is time then to formulate policies that foster rather than hamper our economic well-being. It is time to consider certain reforms.

The Japanese, for example, require their corporations to make only annual, not quarterly, reports, which probably contributes to a longer term view. We might consider doing the same.

We might consider redirecting our Department of Commerce in the direction of Japan's MITI, giving the Department a longer range, more dynamic thrust by developing its role in promoting U.S. exports.

In the area of antitrust policy, we need to adopt the more subtle and realistic approaches that we heard this morning from William Baxter. That is, we cannot assume that size or concentration alone imply inefficiency or a constraint on competition.

We cannot realistically assess competition among domestic firms without considering the international competitive environment. We must recognize that the chief competition within one industry may be a very different kind of product or service. In the hotel business, for example, we are acutely aware of the competition we face not only from other hotel firms but from electronic communications, which may displace some of the demand for travel.

In conclusion, the increasingly competitive international context of the American economy requires us to become more sophisticated in our understanding of economic performance and productivity measurement. It requires that we recognize dramatic shifts in the nature of our domestic economy. It requires that we be keenly aware of the impact of public policy on the competitiveness of U.S. business.

I have offered you the following as first steps toward those goals. First, we must adopt a measure of economic performance to reflect our real goals, recognizing that the key to productivity is not only the quantity but the productive efforts.

We must focus on human resource development as well as technological development if we are to reverse current productivity trends in an increasingly service dominated economy. We cannot continue to ignore the growing service sector in our policy formulations on the subject of productivity.

Government and industry alike must take a long-range strategic view if we are to adapt our economy to these real changes in economic realities. Government must act with more consistency and certainty so that the private sector can plan its future. Legislators and regulators must begin to play a role in fostering economic growth rather than acting as adversaries to business.

I appreciate the opportunity of being here. I look forward to answering your questions.

Senator QUAYLE. Thank you very much, Mr. Rose. Without objection, your prepared statement will be inserted into the record.

[The prepared statement of Mr. Rose follows:].

THE PRODUCTIVITY CHALLENGE TO AMERICA'S FUTURE

Testimony before
The Subcommittee on Employment and Productivity
U.S. Senate Committee on Labor and Human Resources
April 16, 1982

by

Michael D. Rose,
President and Chief Executive Officer,
Holiday Inns, Inc.

MR. CHAIRMAN:

I am pleased to have the opportunity to address the Senate Subcommittee on Employment and Productivity on a subject which is of pressing importance to the future of the American economy: productivity.

My name is Michael D. Rose. I am President and Chief Executive Officer of Holiday Inns, Inc., the world's leading hospitality company. Our Holiday Inn hotel system is the world's largest, operating more than 1750 company-owned and franchised hotels with 310,000 rooms in 56 countries and territories. Our gaming operations, under our Harrah's subsidiary, is the nation's largest, with interest in all major U. S. gaming markets. We also have significant interests in transportation and restaurants through our Delta Steamship Lines subsidiary and our Perkins, Inc.'s family restaurant chain, which has locations in 27 states.

We are concerned with the issue of productivity, not only as it relates to the economic performance of Holiday Inns, but as it relates to the performance of the American economy as a whole, and to U. S. competitiveness in the world market.

Few would argue with the observation that the United States today is experiencing economic hard times. Inflation, recession, high interest rates, low savings rates -- all are symptoms of our current economic distress. We are slipping in the world market, we are losing our competitive edge, and some of our traditional basic industries seem on the verge of collapse. Inevitably, the slew of dismal statistics that describes our economic woes centers on the critical issue of productivity.

Productivity is most often defined as the ratio of dollars of output to hours of labor input. Specificially, this is the productivity of labor. By conventional measure -- and conventional definition -- the growth rate of American productivity is slipping behind our foreign competitors. Of all the industrial countries, only Great Britain had a lower productivity growth rate during the past decade. Between 1948 and 1965, our average productivity growth rate was 3.2%. From 1965 to 1973, it fell to 1.3%, and from 1973 to 1978, the American productivity growth rate dropped to below 1%. Since 1979, our productivity has actually declined. That we have a "productivity problem" is widely recognized, and that is, obviously, why we are here today.

To begin, I submit that there is a flaw in our most common definition of productivity. That is not to say that we don't have a problem -- but the usual measure of productivity inhibits our ability to understand the nature and causes of the problem. Defining productivity simply in terms of dollars per labor hour really tells us next to nothing about the true productivity of labor. For example, fluctuations in price create nominal changes in productivity which do not reflect any real change in the efficiency of the American workplace. In addition, that formula fails to take into account the quality of the output -- a very real concern in light of the nature of foreign competition. Japan, it seems, has been producing better cars, not just more cars, more efficiently.

We do not really believe, then, that a wheat farmer, using the same production resources and techniques, is far less "productive" this year than last simply because the price of wheat has dropped. Nor should we be satisfied if an assembly-line produces more cars that are destined to fall apart prematurely. Goods and services may get better or worse or simply very different over time; yet ordinary productivity measures may not reveal any change.

More important, perhaps, is the fact that many changes in the quality of production occur in areas external to the marketplace, creating illusory declines in productivity simply because costs are measured while benefits are not. Thus, the compulsory installation of seatbelts -- credited with saving many lives -- falls on the negative side of our productivity formula. On the other hand, the $15 per vehicle saved by not making the Pinto's fuel tank safe from explosion, technically would be counted as a positive contribution to productivity.

I suspect that our commonsense understanding of what "productivity" means is a more useful guide to improving the real health of the U.S. economy than the conventional economic definition that is restricted solely to monetary measures. That is, productivity growth really means achieving more and better output for each hour spent at work. The key to increasing productivity is not working harder or faster, but accepting technical and organizational change that enhances the quality of work.

There seems to be little or no consensus as to the roots of the productivity problem -- even within the context of the economist's narrow definition of productivity. In all likelihood, in the course of these hearings, you have heard all of the following offered as reasons for our productivity problem:

- insufficient savings and investment
- taxation policy
- incompetent management
- organized labor
- insufficient research and development
- workers' attitudes
- unfair foreign competition
- the growth of the service sector
- excessive government regulation
- insufficient governmental cooperation and incentives.

Some economists have gone so far as to admit they have no idea why American productivity appears to be slipping. And a recent Business Week article maintains that American productivity actually is not slipping at all, but that American ingenuity, cash, and productivity have sought shelter in the underground economy, where people are working more and better -- and simultaneously escaping the ravages of excessive taxation.

It is likely that all of the above factors have contributed something to lower economic performance. But analysis that amounts to no more than single-issue economics serves only to obscure the challenge confronting us. And that is: that the very nature of our economic reality has changed dramatically over the past two decades. In all likelihood, our greatest failure has been the failure to recognize and adapt to change.

- First of all, we are operating in an increasingly competitive world economy, one that we generously nurtured into being by providing technological, military, and economic aid to Europe, Japan, and the developing Third World countries. In recent years, the U.S. has grown increasingly dependent on imports for the major share of its most important raw materials. And foreign trade accounts for an ever-increasing share of our total economy. In 1950, total imports and exports were only 7.5% of America's GNP; today, they are about 18% of GNP and are projected to rise to 21% by 1990.

- Simultaneously, the makeup of our domestic economy is shifting. We are no longer an economy dominated by manufacturing. The official economic measures indicate that services now account for the major share -- about two-thirds -- of GNP, and the share that is steadily growing in relation to the others. Furthermore, a growing percentage of jobs in basic industries are, in fact, service jobs. Indeed, 3 million of the 3.6 million jobs added to manufacturing employment over the past thirty years were non-production jobs. It is estimated that only 16% of America's workers actually produce a tangible good.

o And, finally, society's goals are shifting. Concern with the quality of life has led to expanded government regulation -- regulation designed to protect everyone from the consumer to the snail darter. Industry, and ultimately the consumer, have been forced to carry the burden of those costs. So,too, has this concern with the quality of life changed the nature of our labor force. The American worker is increasingly concerned with self-fulfillment, participation in decision-making, and job flexibility.

How can we adapt to these new economic realities? First, by acknowledging these basic changes. Then, by incorporating that understanding into our public policies and business practices.

Industry's major challenge lies in finding new ways to manage people and adapt the workplace to new technologies. Government's aim should be to work with industry to formulate policies that reflect an awareness of long-term economic and industry trends.

Perhaps the harshest economic reality we must confront is our own inability to keep pace in this new world economy. Our share of international trade has dropped from 25% to 17% of all world exports over the past two decades. During the same period, American imports of manufactured goods increased by a factor of 20.

The decline of our own industries is reflected in the growing penetration of foreign-made goods into our domestic markets. The figures on heavy industry are perhaps most disturbing. During the past decade, automobile imports increased by 341%, iron and steel imports by 313%, machinery imports by 501%, and chemical imports by 508%.

Industry leaders and policy analysts have already recognized the root of the problem: that even in manufacturing fields such as electronics, automobiles, and steel our foreign competitors are beating us not with superior technology but with superior organization, labor relations, marketing, government cooperation, and adaptability to foreign cultures.

Gone is the assumption that new technology is the only answer to raising labor productivity. The forgotten element in the productivity formula has been people. Human resource development -- training, developing, nurturing, and most important, communicating with people -- is becoming the top priority for many of America's major corporations. Innovative managers are asking questions like: How do we get labor more involved in the management process? How do we create an atmosphere of job security? How do we establish a cooperative, rather than an adversarial, relationship between management and labor?

The buzzwords that identify such innovations -- quality of work life, quality circles, profit-sharing, flextime -- are simply signals that management is beginning to invest more of its resources in long-term job satisfaction and involvement of the labor force in production.

As a service industry, a labor-intensive industry, we at Holiday Inns are concentrating on fine-tuning our performance measures -- we are trying to determine how best to measure productivity. We have implemented some of those "buzzword" programs -- experimenting with Quality of Work Life, flex-time, better training programs, physical fitness, and employee development programs. These programs are part of a long-term effort to improve the output of our people and quality of our services. We recently adopted a corporate philosophy statement which explicitly incorporates the goal of developing our human resources into our long-range corporate goals.

The most tangible evidence of Holiday Inns' commitment to high standards of service quality is our hotel system's new Room Guarantee Program. Under this program we guarantee our hotel customers that they will be satisfied with all aspects of the services they receive or they will get their money back. We are not, then, simply giving lip-service to improving productivity and quality. We are putting our money where our mouth is.

These new approaches to human resource development that focus on the quality of output hinge on three basic principles. First, that quality is part of the productivity formula. Second, that we must be willing to invest in the security, stability, and growth of the labor force over the long term. And, finally, that change must be thoughtful, progressive, and consistent.

Many of the productivity lessons of the decade ahead should in fact come from the labor-intensive service sector. However, legislators and analysts alike seem to interpret productivity as an issue relevant only to the manufacturing sector. Given the growing importance of the service sector to our national economy, it seems time to address this apparent bias.

Certainly we need to maintain our vital and productive basic industries. Much of the popular talk about a "third wave" and a "postindustrial" society tends to be rather naive. The United States will not be able to enjoy a leadership role in world affairs and a high standard of living with an economy based exclusively on services and information processing. We must be able to compete successfully in the production of tangible materials and goods.

Nevertheless, it is difficult to see how our national income can be increased in the long run if the productivity of services continues to be almost completely ignored by policymakers.

Historically, overall productivity growth rates have been lower in the service sector than in basic industries such as manufacturing or agriculture. And despite the fact that new technologies have produced dramatic productivity increases in certain key service industries like insurance, financial services, telecommunications, and real estate, most service industries continue to be plagued by low productivity growth rates.

Why then have the numerous conferences, studies, public hearings, and legislative programs, all purporting to address America's productivity problems, been so neglectful of the service sector? When we raise this question, we usually hear any of three common answers:

1) The productivity of services cannot be measured.

2) Basic industries create the "real wealth" of a nation; services presumably are not "real wealth."

3) Services play little role in international trade. Our key economic problem presumably is competition from foreign producers and workers in basic industries, not in services.

In fairness, I would concede that there is some measure of truth in each of these three observations, but there is hardly enough to justify the current lack of attention to services. Let us critique these three points briefly.

First, service productivity can be measured and is being measured in industry. Measuring the productivity of services may be ambiguous and difficult, but accurately measuring the productivity of basic industries really is not any easier. As I noted earlier, by their very nature, simplistic monetary measures of productivity provide us with only a quantitative - not a qualitative - yardstick on which to track our economic performance. And qualitative factors are equally important - and equally elusive - whether the ultimate output is a tangible good or a socalled "intangible" service.

The second point -- that tangible assets are "real wealth" while intangible services are not -- is an obsolete view. Certainly, information and services are not going to replace the need for tangible goods such as food, water, energy, shelter, and clothing. But to the extent that information and services enable us to make better use of our resources, the effects of scarcity are offset and real wealth is increased. Energy conservation is a good example. Conservation information and educational services which enabled us to reduce our energy consumption contributed as much to the real wealth of this nation in the last several years as did the development of new oil wells, and at much lower cost.

And finally, services are becoming an increasingly important factor in our balance of international trade. Services now account for 20% of all world trade. Last year, the U.S. earned about $60 billion from exports of services, about 17% of the total value of American exports.

If we genuinely intend to turn our attention to the issue of productivity, we cannot continue to ignore the service sector. We cannot pretend that productivity has nothing to do with people - and everything to do with technology. Some public policymakers are beginning to recognize that we need to focus more attention on the growing service sector. The Service Industries Development Act (S.1233), now pending in the Senate, proposes that we do just that.

Nevertheless, government retains a strangely slanted approach to productivity issues. For example, under the tax legislation enacted last year, it would appear that tax credits would be available for technological R&D aimed at, say, developing a new kind of microwave oven, but would not be available for behavioral and organizational research aimed at improving the efficiency of restaurant service.

Similarly, the Federal Government continues to fund research in the physical sciences but in recent years has drastically reduced its support of behavioral and social science research. Surely this is a misguided approach. Behavioral and social science research is basic not only to innovation and productivity improvement in services but even to the successful production and application of physical technology. I am not calling for the substitution of one kind of research for the other, but I am suggesting that a more balanced approach to research and development is warranted.

Beyond the need to attend more closely to the service sector, there is the question of the overall impact of government policy on reversing America's productivity decline.

First of all, we can't ignore the fact that government has contributed to the productivity problem. Murray Weidenbaum, Chairman of the Council of Economic Advisors, estimates that every dollar Congress appropriates for regulation imposes $20 in costs on the private sector. And a handful of widely circulated studies place the cost to industry of compliance with federal regulations at anywhere from $60 to $130 billion a year. Much of this produces real social benefits, but much of it is simply wasteful or overkill.

Given conventional measures of productivity, it probably does not in fact take more on-line workers more time to produce at the same level as a decade ago. But it takes many more functions -- staff functions, reporting functions, even storage functions -- to continue producing at the same level.

For example, when we began looking into a storage and retrieval system for government documents -- to meet government requirements -- we determined that 1300 separate statutes existed requiring some degree of document retention. In order for us to comply with franchise disclosure regulations, we must file reports that accomodate laws in 15 separate states as well as the Federal Trade Commission. And it takes two full-time staffers several months to put together reporting data for the

Affirmative Action program each year -- primarily because, each year, the computer program has to be adjusted to fit new government reporting requirements.

I am not suggesting that we do away with affirmative action or franchise disclosure regulation. However, uniformity and consistency should be rules of thumb for the acceptance of any new regulations. Where regulation is necessary, we must make every effort to streamline the reporting requirements. Special care should be taken in introducing any legislation that serves a function the court system may already provide. After all, our present legal system offers a far less expensive monitor of compliance than do our regulatory agencies. Regulation inevitably burdens the vast, already-compliant majority in an effort to seek out the offending minority.

In the future we need to adopt a realistic attitude toward government regulation. There are three major reasons why regulation exists: because regulated industries themselves demanded regulation as a way to shield themselves from competition; because the short-sightedness of some industry management led to abuses of the public that demanded government intervention; or because inevitable imperfections in the market system create a genuine need that only government regulation can satisfy.

Where regulation is irrational or obsolete we must continue the trend towards deregulation. Where regulation is genuinely needed, we must seek efficient mechanisms which maximize the opportunity for private sector initiative and creativity. In general, a reasonable approach to needed regulation should establish measurable goals, provide some positive incentives for compliance, and leave wide latitude for private initiative in finding the best approach for achieving those goals.

Among the most important challenges we face in solving the productivity crisis is to broaden the scope and to lengthen the time horizon of our management decisions. Critics of American business are almost unanimous in the view that a key element of the productivity dilemma is the lack of long-range, strategic planning and management in American industry, and also in American government.

The really tragic aspect of this problem is that I know very few leaders in business, or for that matter government, who are not eager to develop and act with a longer-range, strategic view. Yet in business we seem to be held hostage to the short-term, rapid-rate-of-return, quarterly-report tyranny of the financial markets, while the government is increasingly dominated by the short-range, special-interest, media-pressured demands of the next election.

Strategic business planning is highly complicated in an environment of high inflation, high interest rates, and erratic regulatory requirements. And strategic business planning is an absolute necessity if we are to successfully compete in an increasingly interdependent world marketplace. The lack of strategic investments in increasing productivity contributes to inflation, reduced investor confidence, erosion of equities, more short-term borrowing, and high interest rates.

In desperation, consumers, workers, and businesses turn to quick fixes from government, leading to short-range, erratic government policies, deficits, depressed financial markets, more inflation, more regulation, high interest rates, declining productivity. Industry and government must work together to break this vicious cycle.

Government could start by reducing the climate of uncertainty which currently surrounds economic decision-making. A perfect example is the current debate surrounding the

Administration's Economic Recovery Act. In October, amid much fanfare, government announced a package of budget cuts and tax reductions. But even as we speak, Congress is talking about repealing much of what is fundamental to that legislation. How can management make long-range decisions when the government, in effect, refuses to chart a course and stay on it? Our political leaders must have the courage to recognize that will take more than six short months to reverse fifty years of economic disincentives from government -- regardless of whether an election looms on the horizon.

Government has to discipline itself to take a longer-range view of its policies, and has to help create an environment where business has confidence, certainty, and incentive to do the same. It is time, then, to formulate policies that foster rather than hamper our economic well-being and it is time to consider some much-needed reforms. The Japanese,for example, require their corporations to make only annual, not quarterly reports, which likely contributes to longer-range thinking for which Japanese business is known. We might consider doing the same. Also, we might consider rejuvenating our Department of Commerce somewhat along the lines of Japan's MITI, giving the Department a larger role in promoting U.S. exports. Similarly, we might consider putting NASA and Department of Energy science and technology programs under the Commerce Department's banner to foster collaboration between government and industry in the realm of research and development.

In the area of anti-trust policy, we need to adopt the more subtle and realistic approach advocated by such thoughtful observers as William Baxter and Lester Thurow. We cannot assume that size or concentration alone imply inefficiency or a constraint of competition. We cannot realistically assess the competition among domestic firms without considering the impact of international competition. And we must recognize that the chief competition with one industry may be a very different kind of product or service. In the hotel business, for example, we are acutely aware of the competition we face not only from other hotel firms but from electronic communications which may displace some of the demand for travel.

We must recognize that bigness per se is not the issue. Holiday Inns is the largest hotel company in the world, but we don't feel that's an obstacle to our being an effective competitor in an extremely competitive international industry. Our computerized reservations system, for example, now handles more requests than all the major airlines combined -- and at a cost per reservation of about one-third that of the next largest hotel chain.

Similarly, our size enables us to invest in system-wide productivity improvements that smaller companies might not be able to afford. For example, our Operations Management Systems, instituted in 1979, is designed to improve labor scheduling and quality control. It took three years and almost $10 million in research and development funds to implement this program, but it has already paid for itself through substantial quality and productivity gains.

Size or market share should not be the issue. Quality, efficiency, productivity, and competitiveness in the world economy -- these are the issues. As Senator Gary Hart has said:

- o Bigger isn't better -
- o Smaller isn't better -
- o Better is better.

In conclusion, the increasingly competitive, international context of the American economy requires us to become more sophisticated in our understanding of economic performance and productivity. It requires that we recognize dramatic shifts in the nature of our domestic economy. And it requires that we be keenly aware of the impact of public policy on U.S. competitiveness. In order to do so, we must revise our thinking. We must challenge our assumptions. And we must be willing to do some thoughtful, long-range planning -- in government and in industry.

I offer you the following as first-steps towards those goals.

- First, we must adapt our measures of economic performance to reflect our real goals - recognizing that the key to productivity is not simply the quantity but the quality of our productive efforts.
- We must focus on human resource development, as well as technological development, if we are to reverse current productivity trends.
- We cannot continue to ignore the growing service sector in our analysis and policy formulations on the subject of productivity.

- Government and industry alike must take a long-range, strategic view, if we are to adapt our economy to changing economic realities. The government must begin to act with more consistency and certainty so that the private sector can plan its future. And legislators and regulators must begin to see their role as one of fostering economic growth, rather than acting as adversaries of business.

Our common goal must be to increase our competitiveness in the world economy. We can only do so by first changing our approach to our productivity problem. As our economic realities have changed, so must we change our way of looking at economic reality.

Senator **Quayle**. Mr. Campbell?

Mr. **Campbell**. Thank you, Mr. Chairman. I shall try very briefly to summarize the points that I made in my paper as well as commenting on some of the points made in the testimony here this morning.

There are three major areas on which I would like to touch. First are some general comments on the nature of the productivity problem and perhaps some cautions about some of the things that are being said about the causation of the productivity problem. Second, following what Mr. Rose has already said, is to add some comments about the significance of the service sector to our economy and therefore the significance of the problem of lack of attention to the service sector by governmental statistical agencies and by public policy in general.

Third is a comment about productivity in the public sector itself, not in relation to how the public sector impacts productivity in the private sector but, rather, the productivity of government in delivering services to the citizens of this country; that is, governments at all levels, Federal, State, and local.

First, as to some general observations on the productivity issue, I do not think anyone can deny the significance of the problem. Scholars and academics may differ as to what the exact size of the decline in the rate of growth is, but there is a general consensus in the literature that such a decline has occurred. In my paper I cite the work of the Committee for Economic Development, a group in which both Elmer Staats and I are involved, and the consensus there about the nature and direction of the problem.

If we had had the same productivity growth in the last decade as we had in the decade from 1955 to 1965, personal income in this country would be 25 to 30 percent higher in real terms than it currently is. Congress might even be struggling with what to do with a surplus rather than worrying about a deficit, although Congress does have an unusual ability to spend however much comes in.

In looking at causation in relation to this problem, I think it important that we not only examine some changes in the American economy that have occurred during this period of decline but that we also take a comparative look at other countries and try to determine whether there are some differences which might help us to explain our current situation. It seems to me when you do that many of the causes that are frequently suggested to explain the decline in this country must be questioned. For example, the decline in productivity in the United Kingdom which began in the last part of the 19th century and continued into the early 1900s occurred in an unregulated economy with no corporate income tax and no antitrust laws. Yet, the decline took place. So, if one is going to attribute our decline to those things, then you have a problem of explaining away what happened to the United Kingdom.

Second, if you look at the increase in productivity among our competitors, Japan, West Germany, the Scandinavian countries, you will find that they, particularly on the European side, have as large a proportion of their economy in the public sector, larger in most cases, than we do. Their health and environment regulations are probably more severe than our regulations.

So, causation is a very complex issue. I sometimes think that it may be that we need to more carefully examine the more difficult area of what I call the soft side of causation, that is work force motivation, the kind of managerial issues which Mr. Rose raised, the issue of training and development, and so forth, rather than looking at more easily measured causes; that is, savings rates and investment, which I sometimes think we look at because there are numbers that we can use to measure it as opposed to the significance and importance that it may have.

Let me turn now just briefly to the service sector. I will not repeat the data that Mr. Rose has already given to demonstrate the importance of the service sector to our total economy, now accounting for between two-thirds and three-quarters of that economy, depending on how you count it. Some 65 to 70 percent of the labor force, some 57 percent of gross national product now comes from services.

We do not have very good measurement devices in the service sector for looking at the productivity issue. The historical data tends to indicate that services have growth at a productivity rate of about 50 percent of manufacturing, although that has not been true for the last decade.

We also have tended to ignore the importance of services in our international trade. This country would be seriously in the red in its trade balance were it not for the fact that the surplus that we do have is caused exclusively by trade in services. Fortunately, the Office of Trade Representative is beginning to look at the question of encumbrances to trade in services. We currently have a competitive edge in trade in services. Both West Germany and Japan, for example, are net importers of services.

An interesting question: Will we lose our competitive edge in services as we have already lost our competitive edge in manufacturing? I would think that that would be a matter that there should be considerable attention given to by both the executive and legislative branches. I am delighted that there is a new organization coming into being, in fact will be founded on Monday, the Coalition of Service Industries, with the leadership being taken primarily by Mr. Robinson, the CEO of American Express, which will try to direct some public attention to these service issues.

Turning to my third point, which is the question of the productivity of the public sector, and here I repeat that I am not talking about the impact of the public sector on private sector productivity but, rather, the productivity of the public sector in delivering services itself, all the way from garbage collection to police services to education services to mailing social security checks, and the like. I hope Elmer Staats will say some words about this, too, because he was a pioneer in developing some measures of productivity in delivery of Federal services, measures, by the way, which I think are vastly underutilized by OMB and other executive agencies in making budget and other decisions.

There are problems of measurement which I have spent some time in the paper discussing and will not repeat here. They are, in my judgment, solvable problems that will require some resources, primarily resources that could be, I think, effectively used by the

Bureau of Labor Statistics in improving its measures as well as by the Department of Commerce.

About 17 percent of the civilian labor force in this country works for Government. About one-third of GNP is expended by Government, so, we are talking about a very significant part of our total economy. It is not possible to directly compare public sector productivity to the private sector because the national accounts which depend on unit prices, simply do not apply to the public sector. To the extent that public sector productivity data appears in national account reports, it is a wash item because it is inputs that are measured and not outputs. Therefore, it is not a useful measure.

The data that is collected now by the Bureau of Labor Statistics through its special program of productivity measurement in the Federal sector does provide a bit of evidence. The 65 percent of the Federal Government which is measured has had since 1967 by those measures an annual growth rate in productivity of 1.4 percent a year, which in these days compared to the private sector is not bad. But one has to be careful in using that data because it is not directly comparable.

If you look at another body of data which, unfortunately, has not been carefully analyzed, that is the outcome of the A-76 process through which the Federal Government decides whether it should contract out a service, as well as some of the research which has been done on the contracting out by the State and local levels, I think you can generalize with some confidence that, by and large, there is approximately a 20- to 30-percent savings possible when public services are contracted out to private firms.

By the way, that is only in small part a result of lower pay and lower fringes in the private sector for most of these areas but is primarily the result of the use of less manpower by the private firm in delivering a service than when it is delivered by the Government itself.

I would, however, argue that most public services are going to continue to be delivered by Government units themselves. That suggests that we should spend some time looking to improving productivity in that sector. When I was Chairman of the Civil Service Commission during the Carter years and then Director of the Office of Personnel Management and through the Civil Service Reform Act, we made an effort to bring some of the discipline of the bottom line of the private sector to the Federal Government by creating incentives, by making it easier to deal with inadequate performance, and to make performance appraisal include productivity improvement as one of the key elements in determining for the management level whether they would get pay increases and the like. That system is in place. I have been tremendously disappointed, as has the General Accounting Office, by the Office of Personnel Management for its abandonment of my concern about productivity, its lack of leadership to the other Federal agencies. I am trying to avoid here a sour grapes kind of response to the changes of priorities in the agency I once headed, but I am disappointed that the well started momentum to accomplish improvements in Federal productivity has been lost.

Thank you very much, sir.

Senator **Quayle**. Thank you, Mr. Campbell. Without objection, your prepared statement will be inserted into the record.

[The prepared statement of Mr. Campbell follows:]

PRODUCTIVITY IMPROVEMENT IN THE SERVICE SECTOR:

THE PUBLIC SECTOR'S ROLE

Testimony before the Senate Subcommittee
on Employment and Productivity

by

ALAN K. CAMPBELL
Executive Vice President
Management and Public Affairs
ARA Services, Inc.

I appreciate this opportunity to testify before this Subcommittee on Employment and Productivity. Productivity with its impact on the state of our economy, on our ability to complete in world markets, and on our potential for growth and the creation of jobs is vital to the future of the American economy.

While there has been some dispute on statistics and specifics, one thing most economists and students of our economic system agree on, is that U.S. productivity growth has decreased significantly and alarmingly. The Committee for Economic Development in its on-going analysis of the productivity problem after a review of the many studies of American productivity concludes in the current draft of its report: "Unfortunately, it is impossible to provide any single set of numbers that represents a consensus of all those who have studied the problem. Virtually every report provides different numbers. Nevertheless, despite their quantitative differences, the available studies are virtually unanimous in their qualitative conclusions about the magnitude and duration of the problem."

The downturn began in the mid-sixties and has persisted through several turns of the business cycle and shows no signs of resuming the growth rates of the fifties and early sixties. The consequences are both domestic and international. Without productivity growth standards of living decline, inflationary forces are reinforced, resources available to solve social and environmental problems are reduced and, if productivity growth lags behind that of other nations, our competitive position declines.

The causation for this decline has been attributed to a variety of factors including, decreased investment by business, lower savings rates by the public, reduced research and development funding, higher energy costs, and the larger percentage of industrial budgets allocated to necessary, but non-productive areas such as health, safety, and environmental protection.

It has also been argued that the structural shift in the U.S. economy, in macro-economic terms, from a manufacturing base to a service dominated one has also decreased productivity because of the historically lower growth rate in service productivity in this labor-intensive sector. Until the recent downturn in overall productivity growth, service sector productivity grew at only half the rate of the manufacturing sector.

If productivity grows more slowly in the service sector, and if that sector is becoming an increasing proportion of the total economy, it follows that the overall productivity rate will decline. The service sector's share of total employment has risen substantially since the end of World War II, increasing from just over half of the work force to approximately two-thirds with projections of 72 percent by the end of this decade. Ninety percent of all employment growth over the past six years has been in the service sector. Much of that employment has meant jobs for the millions of displaced workers who have come from industrial plants which have modernized or shut down and from agriculture. The service sector has also employed the millions of baby boom young workers, women and minorities who have entered the work force in recent years for the first time. Today, some 57 percent of our GNP comes from the service sector. Students of productivity who have examined the impact of the shift of our economy to services differ about its role in the overall decline of productivity. Some attribute as much as half of the decline to the shift, others attribute a much lesser role to it. During the recent period of general decline in productivity, the service sector as the table below shows, has not performed any less efficiently than other segments of the economy.

GROWTH OF INDUSTRIAL PRODUCTIVITY*

Industry	1948-65	1965-72	1972-77	1977-79
Agriculture, Forestry, Fisheries	5.0%	4.1%	1.6%	2.3%
Mining	4.3	2.4	-4.8	-4.2
Construction	3.4	-1.8	-1.4	-5.9
Nondurable Manufacturing	3.3	3.2	3.2	1.9
Durable Manufacturing	2.8	2.3	2.5	0.2
Transportation	3.1	2.4	1.9	-0.2
Communications	5.4	4.5	6.5	4.4
Electricity, Gas, Sanitary Services	6.3	3.4	2.4	-0.9
Wholesale Trade	3.2	4.0	0.0	-1.2
Retail Trade	2.6	1.8	1.6	1.1
Finance, Insurance, Real Estate	2.0	0.8	1.7	-1.6
Service	1.2	1.6	1.0	0.7
Private Business Economy	3.3	2.3	1.8	0.2

---

* All sectoral data come from U.S. Department of Commerce, "National Income and Product Accounts of the United States," Survey of Current Business. July various years, Tables 6.2 and 6.11.

The question of service sector productivity assumes a particular urgency in the light of the growing importance of services in our balance of trade. First, at the time when foreign competitors are consistently reducing American market share in exported goods, the export of U.S. knowledge and expertise in the form of services resulted in a $40 billion service trade surplus in 1981. That put our overall balance of payments $12 billion in the black and resulted in a stronger dollar abroad.

Today, the United States posseses a strong international competitive edge in the services, but that superiority could be in jeopardy, could be lost just as our competitive edge in manufacturing is being lost.

The demand for more services is in large part a function of the amount of income a person or family has. As personal income rises, more of that increase is devoted to services. Since the U.S. has had a high per capita income, the demand for services has been growing. In 1981, for example, the percentage of real personal consumer dollars spent on durable goods decreased, while the amount of services increased dramatically. According to the U.S. Commerce Department, last year (in constant 1972 dollars) Americans spent over $230 billion on durable goods, but over $880 billion on services.

The early development of services and service delivery systems gave the U.S. a jump on most other nations in this field. Japan and West Germany, for example, are net importers of services. But, they and other nations are catching up quickly. As income rises in other countries, their demand for services is rising as well. So far, American companies have taken advantage of these opportunities for trade growth. However, our advantage may not last for long. Income levels in other countries will not need to reach the current U.S. per capita level of GNP before they, too, move to more service dominated economies. Foreign companies are already learning service sector techniques, technology and management practies.

The international transmission of knowledge is occuring at an accelerating rate as more detailed knowledge and experience is gained in the relatively new field of service management.

Therefore, the challenges to our current competitive advantage in service will grow more intense. This is exactly what happened to our manufacturing dominance. Our technology and innovation was copied, improved upon, and used against us.

Our competitive edge in service delivery can only be maintained through continuous productivity improvement. Because it is easier, albeit difficult enough, to measure inputs and outputs in the production of goods, most attention has been focused on that. Important as determining the cause or causes of the decline in productivity growth in manufacturing is, it is more important to know how we are doing in the largest and most rapidly growing part of the economy.

Measuring the output of services is inherently more difficult than measuring manufacturing, construction or agricultural output. Quality changes are more difficult to detect, consumption frequently occurs almost simultaneously with production, and inputs are often difficult to distinguish from outputs. In fact, current productivity measures "include some sectors for which estimates of the change in real output are estimated either entirely or mainly from changes in inputs, including finance and insurance and portions of the services and construction sectors."*

---

*National Research Council Measurement and Interpretation of Productivity, National Academy of Science, Washington, D.C., 1979, p. 8

These measurement problems must be addressed and I urge this Committee to work with the appropriate executive agencies, particularly the Bureau of Labor Statistics, to determine what resources need be applied to improve productivity measures in general and particularly for services.

There has been a pre-occupation in data collection and analysis with the manufacturing sector at the expense of the faster-growing, higher-potential service sector. This emphasis on manufacutring is demonstrated by the nature of the statistics collected by the government. The current industrial codes used by the Commerce Department is strongly skewed in favor of the goods-producing industries. My employer, ARA Services, for example, is a $3 billion diversified international service management corporation with 110,000 employees. Yet, there are few of the industry codes used by the government to collect data which fit exactly the lines of business in which ARA is engaged.

Likewise, the data collected and analyzed by the government lacks the precision and quality in services that it has for manufacturing. There are 10,000 different classifications for reporting imports and exports in goods. Yet, only six for reporting service transactions.

Analysts and scholars outside government also should devote more attention to the service sector. ARA Services hopes its plans to endow a Service Sector Institute at a major business school will make a modest contribution to meeting this need.

Areas of concentration for this institute will include efforts to develop better measurement tools for services and ways to encourage and expand productivity in the delivery of services. ARA will provide the seed money for the operation of this much needed center with the hope that additional resources will be attracted from other national and international sources. To begin this effort, we are also funding a conference this fall to be sponsored by the center which will bring together business and government leaders, academicians and economists to discuss and analyze the problems and opportunities confronting the service sector.

It is also encouraging that major service sector companies are organizing to work together to help solve their problems and take advantage of their opportunities. They are establishing an organization to be called the Coalition of Service Industries which will focus its attention on both international trade issues and domestic concerns including the productivity issues.

Some members of Congress are also turning their attention to the service sector and legislation has been introduced which will direct more executive agency attention to services, particularly to international trade in services. James Robinson, Chairman of American Express and one of the founders of the Coalition of Service Industries, has recently warned that "the potential for growth in U.S. service exports is tremendous as long as foreign markets remain open. Barriers, both visible and invisible, to trade services are in place and growing. As the world economy undergoes service strains, the barriers will multiply.

For the U.S. to continue to compete successfully in those markets will require continuous improvement in service productivity. Conscious efforts to accomplish that are vital and the first step is to recognize its importance.

My comments thus far have been directed to the private portion of the service sector. That focus omits a large part of the service sector — government.

The public sector — federal, local, and state government activities —involves about 17 percent of total civilian employment and accounts for about one-third of the nation's gross national product. Government is, therefore, a very large part of the service sector since nearly all its activities are service oriented.

There are many who believe, and not without some reason, that government and productivity are incompatible concepts. However, today, with federal cutbacks, personnel reductions and calls for increased efficiency, it is incumbent on public sector managers more than ever to encourage higher levels of productivity.

Again though, all the problems related to measuring services apply to the public sector, there are additional difficulties as well.

The federal government has been attempting to measure its productivity for over a decade, with some success.

Beginning in 1967 over half of federal activities have been measured but the measurement techniques differ from those used for the private sector. Before commenting on those differences, the system that is used covers 28 functions and over 2,500 output units. They are the products produced by 347 organizational entities which cover 65 percent of federal employees. There has been an annual increase in federal productivity of 1.4 percent since 1967. Placing that against changes in labor costs produces an annual 7.2 percent increase per unit labor cost.

If you compare this to private sector productivity over the same period, the federal government is not doing badly. Unfortunately, that direct compairson cannot be made because in the national income and product the measurement of the federal, state and local portion of the total ecnomy is included as a "wash" item because inputs are measured rather than outputs as is also true for some part of the private service sector. The result is we cannot make direct comparisons of the government productivity changes with those of the private sector. Government output is not priced, nor are there units of output that are exchanged in the marketplace thereby making it difficult to include public sector output in the national income and product accounts.

Going beyond the technical measurement problem, some argue that it would be inappropriate to try to measure the outputs of some governmental services. For example, a recent report of the National Research Council of the National Academy of Science argues:

> "...but the uncritical extension of productivity statistics to inappropriate areas is not only useless and hence a waste of resources, it can also be harmful. To specify which areas are inappropriate is not easy but two general conditions are relevant. Productivity statistics are not helpful and may be harmful when there are no clear measures of output and when there is no well understood technology, that is, no efficacious procedures for reliably converting inputs into output. For example, organizations such as schools, many types of government agencies, and community health agencies may lack clearly defined goals or demonstrably efficacious techniques for achieving them. Since they usually do not sell their output in a market there is no simple way to ascertain the value attributed to their products or services by those who use them. Attempts to apply productivity measures to organizations lacking clear output measures can produce unanticipated and perhaps undesirable effects. To push too hard for the development of clear and measurable objectives can result in a distortion of functions such that less important but more quantifiable objectives drive out more important but diffuse goals. For example, excessive attention to the learning of specific skills in professional schools may allow less time for the development of diagnostic judgment or ethical standards. Goals may be further distorted in situations in which performers or evaluators emphasize maximizing evaluation scores rather than performance quality. For example, pressures on schools to adopt competent-based evaluation systems can lead to the development of teachers who teach and students who learn to the test."

This caution may apply to a small part of public sector activities, but for much of the public sector it is a "cop-out." Most of what government does is measurable whether it is garbage collection, street repair, the preparation and mailing of social security checks, or the maintenance and operation of a military base. Micro-measures of productivity being developed by many private firms have equal application to government.

There are, however, more serious obstacles to improving productivity in government than the measurement ones. The decision-making system, for example, in not designed to make tradeoff decisions between capital, labor, and materials. In budget-making, this question is seldom raised. One hindrance is the fact that capital is paid for in the year it is acquired and it is not depreciated. A new computer may be more efficient and cost-beneficial, but its cost must be amortized in one budget year in government, thus meaning it may be impossible to budget for it. In other words, appropriate calculations about the long-term value of capital investment are not required by the government's accounting system.

There are also other disincentives to productivity improvement inherent in the system.

For example, if efficiencies are introduced which result in the use of less resources, the manager is likely to have his budget reduced — and, of course, budget is an important status symbol; an indication of how well you're doing in government.

Likewise, if a manager makes his or her department more efficient by using fewer employees, he or she may see their grade reduced because they are supervising fewer.

Further, the historical trend in civil service system has been toward more and more employee protection. The result is that many of the personnel management tools taken for granted in the private sector are simply not available to the public sector manager.

It was to remove these disincentives that we developed the Civil Service Reform Act of 1978 when I was Chairman of the U.S. Civil Service Commission. When Congress passed this Act the U.S. Office of Personnel Management was created of which I was the first Director.

The new legislation makes it easier to discipline employees for inadequate performance. It replaced automatic pay increases for federal managers with incentive pay based on performance. The legislation also created the Senior Executive Service for the top 7,000 managers where rank is with the person and not his or her job; membership is based on performance; and a bonus system which rewards outstanding achievement.

Under the Civil Service Reform Act, productivity improvement is possible through better management. It enables managers to get rid of "dead wood" and provides incentives to cut costs and streamline operations. Their raises, their bonuses, and their jobs depend upon it.

I have left public service for the private sector where the "bottom line", profit margins, profit centers, and return on assets are the guiding forces. Yet, the philosophy we developed for government service in 1978 is consistent with the management techniques used by companies that must survive in the highly competitive marketplace which rewards success with profits and failure with extinction.

Although this new management system has not had sufficient time to be tested — it is possible that the public sector is inherently incapable of improving productivity — I still worry if it will be given a fair evaluation.

Since leaving government I have not followed closely the implementation of the Civil Service Reform Act but I an disturbed by what I hear and read about the reduced emphasis by the Office of Personnel Management on productivity improvement.

Less than a month ago the National Productivity Group of the General Accounting Office testified before the House Subcommittee on General Oversight on "The Continuing Need for Productivity Improvement" and told your House colleagues: "OPM's program as designed to assist federal managers in improving productivity through management analysis, improved measurement and information sharing among managers in the federal government and the private sector as well. There officials are concerned that this support from OPM has been virtually eliminated and they now lack any central support and assistance. Many productivity officials believe the elimination of OPM's support may hinder their agencies' efforts to develop and improve effective productivity improvement programs. We are concerned that not enough is being done."

GAO's concern was echoed again later in their testimony when they noted "OPM's program has been virtually eliminated just as it was getting up to speed. We have not seen any significant alternative government -- wide strategy put forth by the administration. Frankly, we are puzzled by this apparent de-emphasis on productivity during a period of budget reductions. Federal managers need some help in reaching the productivity goals we believe they should be striving for, and that will enable them to produce, despite reduced funding."

Fortunately, some agencies are continuing their productivity improvement effort despite OPM's declining leadership role. The Defense Department has established a Council on Integrity and Management Improvement which its Chairman, the Deputy Secretary of Defense, describes as being a "conduit through which cost-cutting recommendations can be disseminated to every echelon of the Department." Membership of this Council also includes the undersecretaries of the military departments.

GAO points to productivity improvement activities by the Air Force, Navy, and Army as examples of good efforts. GAO singled out the Air Force program for specific mention by stating: "A most vital and effective part of this program is the policy that allows savings achieved from productivity improvement to be applied to other approved but deferred activities within the organization responsible for the savings. This is seen by the productivity staff as the best way to motivate Air

Force middle managers to work for savings. This approach also overcomes the notorious disincentive to productivity encountered by most managers, namely budget reductions that match any previous savings."

Also deserving mention are the Internal Revenue Service and the Department of Energy programs.

These programs were aided by OPM's earlier leadership role and GAO notes: "...that officials with these productivity programs and several others we have examined spoke highly of the Office of Personnel Management's Workforce Division's efforts in helping them initiate, implement or improve their programs."

It seems to me that OPM's program is being de-emphasized at precisely the wrong time.

Today, more and more, we are seeing a closer interaction between the public and private sectors. Government is contracting out more of its activities because the private sector can do it less expensively — often with fewer people and with better management.

We are also seeing the private sector pick up new responsibilities as the government pulls back, but private industry cannot and should not carry the full load. It is incumbent upon the public sector to make itself more efficient, more productive, and more concerned.

I know, I am in a not-so-unique position of having been in government and now working in the private sector. Unfortunately, many of the public sector's better managers are coming into the private sector because the rewards are greater, restrictions less, and they are given more clear cut areas of responsibility and accountability.

I still believe as I did when I was in government that the public sector can become as efficient as the private sector. Saying it, however, will not cause it. Lacking the discipline of the marketplace the public sector must find a substitute for it. That substitute lies in my judgment in support from the highest levels of government -- from both the executive and legislative branches -- and in the adoption and use of appropriate incentives.

Taken together, the private and public service sectors offer major opportunities for overall improvement in the American economy.

If the economy is to grow, that growth will come from the predominant service sector of the economy. That will take action from government which makes up a significant part of the service sector. At the same time, government must recognize the important contributions of the service sector and its potential for growth and job creation and enhanced foreign trade opportunities.

All of this rests squarely on the need to increase productivity. Without improvements in productivity, there will be no growth. And without growth, there will be no new jobs.

Our economy will remain stagnant, we will continue to lose ground to foreign competitors and our standard of living will decline further.

A declining standard of living means lower revenues for government, and that means the members of this Committee will be forced to vote for further reductions in already bare-bone critical programs which are needed by the American people.

As you know, it is much easier to distribute slices from a growing economic pie than to preside over the fighting for scraps that we presently see. Congress must help get the federal house in order and productivity is a good place to start.

Unless there is a turnaround in productivity in all sectors of our economy, a no-growth economy will be with us permanently.

Senator QUAYLE. Mr. Staats?

Mr. STAATS. Thank you, Mr. Chairman.

I think I should first clarify. I am listed here as from Truman Scholarship Foundation, which I am, but that is only one of a large number of activities which I have undertaken since my retirement as Comptroller General. I am not testifying in connection with that role.

Senator QUAYLE. The record will reflect that.

Without objection, Mr. Staats, your prepared statement will be inserted in the record at the conclusion of your testimony.

Mr. STAATS. I would like to say that my interest in this subject goes back 20 years. As the Deputy Director of the Budget, we were interested in seeing if we could relate productivity measures to the budget of the Federal Government. We found the work we did there very promising. I continued that interest as I became Comptroller General, working with the Civil Service Commission, the Bureau of the Budget, and the Bureau of Labor Statistics.

My interest in this has continued since retirement. I am currently serving on boards of three different organizations: the CED, the American Productivity Center in Houston, and the Alexander Proudfoot Co., which do work in the productivity field.

I am going to highlight my statement in the interest of time. I would like to refer you to a point that I made here on the bottom of pages 2 and 3. There has been a growing recognition of the need to do something more than we have been doing in the private sector and in the State and local government area. Regrettably, the Federal Government has been the last to recognize that there is a role that it can play in doing something about the productivity problem.

The President has set up a National Productivity Advisory Committee. I congratulate him on that, but I do not think it really fills the need. It is temporary. It is a very large group. It is a study group. It does not really provide a point in the Federal Government which can develop the national strategy and a national plan or program to help the private sector do its job in the productivity field.

A number of efforts have been made, going back to the beginning of the Nixon administration, but these all failed for lack of administration support. So, what I would emphasize particularly today is the need for greater leadership, better leadership on the part of the Federal Government in dealing with this problem which, I think we all would agree, is one of the most serious problems we have as a nation.

I had proposed while I was Comptroller General the establishment of a national council, a Federal council of productivity, which would have a full-time chairman appointed by the President, confirmed by the Senate, to be statutorily based. It would be made up of the heads of the principal Federal agencies who in turn would pull together business and labor to develop a national plan or national productivity program. Senator Bentsen has introduced this bill. Congressman Lundine and Congressman LaFalce introduced similar bills in the House.

As a suggestion, you might want to take a look at the testimony on that in the record. I believe that something along that line could be very helpful.

As others have pointed out, and I point out on page five, we really do not know, at least we cannot quantify, all the reasons for the decline in productivity, which, as you pointed out earlier today, started many years ago, at least 15 years ago. The decline has been steady. It has been one which really has not been dealt with in the manner which I think we need to deal with it.

The fact that we cannot state definitely what are the dominant factors here, however, should not deter us from moving ahead on the things that we do know about, even though we cannot quantify them.

I point out on page 6 that the Reagan administration program has four parts to it. Hopefully, these will work. But at this point we do not know. There is growing concern that they may not. But the point I wanted to make is that there is another factor here that we need more specifically directed efforts to foster productivity growth. Even if these four elements do work, I do not think they are going to be adequate to meet what needs to be done.

The coordination of our productivity efforts is important. I point out on page six that the OMB itself has estimated that we are spending as a Federal Government something more than $2 billion a year on various programs designed to improve productivity in the private sector. These are not related. They are not a part of a program. They are all developed as individual segments of agency programs supported for this reason, but no one has really looked at them from the standpoint of priority or their need or as to their content.

On page 7 I point out that some five different things which I believe should be included in a national productivity plan or strategy. These are pretty well reflected in Senator Bentsen and Congressman Lundine's bills.

On page 8 I point out what I think also needs emphasis. That is that, in addition to national measures, we have to look at measures which deal with individual sectors of our economy. While we have had many sectors which have been highly successful and have had high productivity rates, others have not. Of the four major sectors, only farming has had a signifcant increase in output growth if you go back to a period of roughly 10 years.

The Joint Economic Committee has pointed out that from 1948 to 1973 and 1973 to 1979 periods indicate that the capital labor ratio is increasing less rapidly in 11 of 20 manufacturing industries, actually declining in the instruments and miscellaneous manufacturing industries. Part of the decline in the capital labor ratio productivity, that is the output per worker hour, is down in 16 of 20 manufacturing industries.

What I am trying to do in this part of my statement is to point up the fact that there is a high degree of difference, of variability on different sectors of the economy as to the degree of their productivity growth and their international competitiveness.

Macromeasures in and of themselves will not necessarily deal with the problem.

The work we did in the GAO, as I point out on page 10, fell into three general areas: increased adoption and diffusion and new technology and the role the Federal Government could play there, better utilization of human resources, and improved public-private sector cooperation. I list here several reports that were made by the GAO. Also, on page 11 I point up that the Government has done some good work in this field, particularly the Defense Department and the Commerce Department.

On page 12 I point up that the second area where the Government can be more effective is in utilization of human resources. We spend billions of dollars every year on research and training and education for public and private sector employees and potential employees. But few of these programs place any emphasis on their contribution to productivity improvement in the private sector.

I point out here as an example, as the manufacturing sector becomes more capital intensive through the use of technologies such as robotics, the Federal role in retraining displaced workers must be addressed from a Government-wide standpoint. This is something which, as you know, has developed very fast and looks like it will develop even faster in this next decade.

On page 13 I make the point, I believe, that Mr. Campbell and others have made namely that we need to be sure that, when we put the budget together, we are taking necessary actions to strengthen the public infrastructure. These have implications for productivity improvement. The transportation system and the highways and the bridges, are programs which appropriately in the public sector that have to be looked at. If we do not give them priority, then they are going to have a negative impact on the private sector. Similarly, the basic research which has been declining in both the Government sector and the private sector is another area which I think we need to take another look from the standpoint of our priorities.

I point up on page 14 six examples of cooperation which developed between the Government and the private sector by way of emphasizing the importance which I attach to this point. We need more of this.

On page 15 on productivity at the firm level, the more I deal with this problem, Mr. Chairman, over the years, the more I am of the view that the greatest opportunity for improvement in productivity is at the firm level. It is much more so even though macromeasures are important and even though what the Federal Government can do in other ways is important. I think the great hope is to develop on the part of the individual manager a philosophy that he needs to work more closely with his employees. The human factor here, participative management, quality of work programs, and all of these things which have been named are all pointed at the same issue as to how we can get workers and managers to work more closely together. The Japanese have done this so successfully.

I point out on page 16 the GAO report which relates to a study of 20 similar coal mines in Wyoming, production in terms of tons per worker today ranges from 58 to 242. These are all in the same area, all using the same technology. The difference was in the way the managers work with labor to increase output.

I point out on the same page some of the principles of Japanese managers which, I believe, would be applicable, for the most part, to the United States.

On page 18, at the bottom of the page, I say that pursuit of productivity gains will become a major management focus in the 1980's in both the public and private sectors. Falling birth rates since 1965 and the slowdown in the rate of entry of women into the labor force will provide strong incentives to substitute capital for labor, causing a major restructuring of jobs and the management functions associated with them.

I would estimate that this will have its greatest impact in banking, insurance, public administration, and office work generally. A premium will be placed on the manager's role as an innovator and as a catalyst, particularly in the growing information and service sectors of the economy.

Much of what I have had to say today I think also applies to the public sector: technology innovation, capital investments with high productivity improvement payoffs, and the need for a top management commitment and development of a program for employee participation. One particular need is to provide for greater accountability as well as incentives for managers to improve productivity and reduce costs by letting them share in the results of productivity improvements. Such programs have been initiated now in the Internal Revenue Service and the Defense Department, applying the same principles of cost sharing which have been so highly successful in private industry.

Within the Federal Government this can be done by allowing a manager to utilize a part or all of the savings accomplished to meet other high priority needs in his discretion. In this regard, also, we cannot overlook the great importance of individual and group recognition including monetary awards for outstanding work.

These and other actions can be part of a formal agency productivity improvement program with the Office of Personnel Management and the Office Management and Budget providing greater overall leadership, encouragement and assistance. It is particularly disappointing that the program initiated in 1979 by the Office of Personnel Management, to which Mr. Campbell referred, to assist managers in productivity improvement have been virtually eliminated.

In conclusion, I want to emphasize that the current four-part approach to economic recovery, budget reductions, tax reductions, regulatory reform, and consistent monetary policy is missing an equally important fifth prong, a targeted national effort to improve productivity. We need a national productivity effort that is properly supported by the President and the Congress and involves the private sector and is based on an agreed-upon national productivity program. The goal would be to make sense of the numerous Federal policies and programs that affect productivity and establish priorities for the changes that are needed to encourage productivity growth while meeting other policy objectives.

Mr. Chairman, I congratulate you for holding these hearings. I have seen the list of your witnesses. I cannot think of any more important subject that Congress ought to be addressing itself to than this. Productivity improvement is really the barometer of the

Nation's economy. I think we need to have more recognition of this within the Congress as well as the administration.

[The prepared statement of Mr. Staats follows:]

FOR RELEASE
11:30 a.m., Friday,
April 16, 1982

STATEMENT OF ELMER B. STAATS

BEFORE THE SENATE SUBCOMMITTEE ON EMPLOYMENT & PRODUCTIVITY

STRENGTHENING FEDERAL LEADERSHIP IN IMPROVING NATIONAL PRODUCTIVITY

At the outset, I would like to commend you and your Committee for initiating these hearings on productivity and the American economy. That the subject is timely and of high priority is to seriously understate its current significance.

And thank you for inviting me to present my views on the subject. While I am no longer in Government, my strong interest in the subject has continued. In the early 1960s, while Deputy Director of the Budget, I appointed a task force to examine the feasibility of measuring productivity in the Federal Government. Dr. John Kendrick of George Washington University, one of the Nation's leading experts on productivity, served as Chairman. The 1965 report was quite promising. The relevance of productivity measurement to budget analysis is obvious.

In the late 1960s, after I became Comptroller General, I invited the Bureau of the Budget, the Civil Service Commission, and the Labor Department to join the General Accounting Office in a study to see whether it would be feasible to develop a productivity index for the Federal Government, similar to the BLS index for the private sector. As a result of our joint efforts, regular indices of Federal Government productivity change are now published annually by the Bureau of Labor Statistics, reflecting the output of over two-thirds of all employees in the Federal Service.

The GAO subsequently added to its agenda a series of studies dealing with the role of the Federal Government--positive and negative--in fostering improvements in both public and private sector productivity, ranging from the Federal role in computer-aided manufacturing to techniques for sharing productivity gains with employees. GAO's efforts in this important area continue, with a total staff allocated of approximately 50 professional employees.

Currently, I serve on the Board of Directors of the American Productivity Center in Houston. In addition, I am a member of the Board of Trustees of the Committee for Economic Development and, as such, I serve on a panel currently conducting a major study on the causes of decline in productivity growth and ways in which the trend can be reversed. Also, I am a member of the Policy Advisory Board of the Alexander Proudfoot Company, a consulting firm which has earned a distinguished record in the field of productivity improvement in the private sector over the past 25 years.

There is no better barometer of the economic health of our economy than its record on productivity. It is basic over time to our competitiveness in world markets, to improvements in our standard of living, and to the containment of inflation. The growing recognition of this fact is heartening although it is disappointing that this recognition has come so late. A growing number of companies, for example, have established senior officers with company-wide responsibility to advise on and coordinate company efforts to improve productivity; a host of productivity centers have been organized--many based at universities; and the number of visitations to Japan to study their experience has risen dramatically. The recent organization of the American Productivity Management Association--with upwards of 80 members--is a further indication of the growing recognition of the importance of the subject. The Washington-based, non-profit, Center For Public Technology has done excellent work in studies and exchange of information designed to improve productivity at the State and local level.

Regrettably, the Federal Government has been slow to recognize that productivity is a serious problem in either the public or private sectors. As a Nation, our productivity growth rate is the lowest among the major industrial nations and has been declining now for nearly fifteen years. Most of these nations have established productivity centers to provide a focal point to coordinate productivity efforts and take leadership in bringing labor, management, and government together to find ways to enhance productivity. The recent action of the President in establishing a National Productivity Advisory Committee, while encouraging, does not, in my opinion, fill the role which I think is necessary.

In the Nixon Administration, a National Commission on Productivity was established, consisting of senior representatives of labor, management, and government, seeking to identify the sources of declining productivity growth and suggesting actions that could be taken to reverse the decline. This was followed by a statutory National Center for Productivity and Quality of Working Life in November 1975. The Council established by the statute was undoubtedly too large which added to the difficulty for the White House in making appointments in a timely manner. In fact, the appointments were not completed until shortly before the change of Administration. President Carter, in turn, failed to make appointments to the Council, with the result that the Center--established for a three-year life--expired and was not renewed for lack of Administration support. Today, in spite of our problems of inflation, increased foreign imports, and low economic growth, we still do not have an identifiable productivity policy or program.

As Comptroller General, I testified on a number of occasions, supporting the establishment of a statutory Council with a full-time Chairman which could provide a focal point within the Government to take leadership in developing Government policies with productivity improvement as an underlying objective and to provide a neutral forum which could bring together labor, management, and government to consider and recommend policies designed to enhance productivity. I continue to support this proposal which has now been included in bills introduced in both the House and the Senate. I would like to emphasize this need especially in my presentation today.

But first let me be very clear that the role which I am suggesting for the Council would not be one of more government regulation, more intervention by government in the private sector, or anything which could be called developing a national economic plan. In fact, much of the role which I perceive for the Council would be just the opposite; that is, to develop ways to lower or remove barriers established by government which hinder productivity growth. What is lacking is a senior, fulltime official who would have direct access to the White House, agency heads, and the committees of Congress, who can be a spokesman for productivity improvement and the quality of working life. The Council could be vital in what I would like to call "consensus building" on issues which have tended to divide labor, management, and government. It could fill an important educational need. In brief, it could become the spokesman and advocate for those measures which will enhance productivity which involve labor, management, and government in both the public and private sectors.

As awareness of the productivity problem has increased, we have not lacked explanations for the productivity decline. Some have pointed to rising energy and materials costs, the changing composition of the labor force, the deline in the work ethic, and the preoccupation of business managers with short-term gain at the expense of long-term growth. Others have pointed to excessive government regulations, tax laws that discourage capital formation and investment, the shift away from goods production to the service sector, or even the fact that we are now a mature society and can no longer expect continued high productivity growth.

All these explanations have some validity. We cannot, however, state precisely which ones are the dominant factors. The problem of declining productivity is extraordinarily complex. We badly need a better understanding of the sources of the problem and of its broader consequences. Even with partial knowledge, however, we can begin to improve the situation. Some things can--and should--be done now.

The Reagan economic recovery program

The Reagan Administration is trying to implement its economic recovery program. Some have said the Administration's approach to productivity is based on the premise that "tax cuts will result in investment which will result in productivity improvement." Actually, the Administration's productivity program is more complex than that. Designers of the program consider it to be a sharp break from past practices: one that will result in increased rewards for hours worked and money invested. The program uses a four-part approach:

- --Stringent budget policy.
- --Incentive tax policy.
- --Regulatory reform.
- --Consistent, noninflationary monetary policy.

The hope is that this approach will bring about increased investment, lower inflation, economic growth, and, at the same time, restore productivity growth.

No one, of course, can be sure this plan is going to work. Many other, more orthodox, attempts to revitalize the economy have failed in the past. I am sure we all share the hope that it will be successful.

There is one important area, however, that I am afraid the Administration has overlooked--namely, more direct efforts to foster productivity growth. Our Nation's productivity problem cannot be fully solved through changes in overall economic policies. The problem warrants making specific, targeted efforts to stimulate productivity a fifth part of the economic recovery plan.

National policies to encourage productivity

Although our national productivity depends largely on business performance, the Federal Government plays an important role in establishing the broad economic, legal, and social framework within which business operates. This framework, of course, greatly affects productivity.

Coordination of productivity improvement efforts is particularly important because there are so many Federal programs directly related to productivity improvement. The OMB estimated that over $[illegible] billion was spent by the Government during fiscal 1980 on productivity-related programs. Most of these funds support activities to improve civilian technology through applied research and development. Much of the remainder is for skill training and better labor-management cooperation.

Without central guidance and review, these programs cannot be properly evaluated to determine if the current level of funding is appropriate, to identify the need for new programs, or to assign priority to existing programs. That is why I believe that a legislatively based National Productivity Council should be established. The Council should have a full-time, presidentially appointed chairperson and its own budget authorization. The Council should provide oversight, direction, and coordination to departments and agencies having productivity related programs. The Council should report from time to time to the President and the Congress actions needed to make the Federal role more effective.

This report should be developed with the extensive involvement of business, labor, and academic representatives, as well as existing national and regional productivity centers. The goal should be to

--identify and describe the relationship and effect of Federal policies, programs, and activities on private sector productivity;

--delineate clearly the responsibilities of Federal departments and agencies having direct program functions within the plan;

--identify existing unnecessary obstacles to productivity improvement created by the Federal Government;

--provide alternative policies, programs, activities, and lines of responsibility to improve private sector productivity; and

--list short and long term objectives and their priorities, and state specific projects and programs for the next year to attain these objectives.

The result would enable decisionmakers to put productivity-related proposals into a meaningful context rather than to approach each issue on an ad hoc basis.

An effective National Productivity Council and a national productivity program would, I believe, strengthen the Administration's economic program and help ensure long-lasting productivity improvement.

Productivity improvement at the sector/industry level

To reverse the slowdown in productivity growth and meet the challenge of revitalizing American industry, it is critical that the problem be viewed not only at the national level, but also at the sectoral and industry levels. Where it is measurable, the decline of the Nation's productivity can be traced to erosion at these levels. The economy's major sectors include the private domestic business economy, farming, manufacturing, and non-farm, non-manufacturing industries. According to the Joint Economic Committee, since 1973 the growth rate of output has declined dramatically in three of the economy's four major sectors. Only farming has enjoyed an increase in its output growth rate.

This decline in the output growth rate becomes even more apparent when viewed at the industry level. A Joint Economic Committee comparison of the 1948 to 1973 and 1973 to 1979 periods indicates that the capital-labor ratio is increasing less rapidly in 11 of 20 manufacturing industries, and is actually declining in the instruments and miscellaneous manufacturing industries. Partly because of the decline in the capital-labor ratio, productivity (output per worker-hour) is down in 16 of 20 manufacturing industries. As a result, the real output growth rate has declined, relative to the 1948 to 1973 experience, in 17 of 20 manufacturing industries. The experience of the non-farm, non-manufacturing industries has been similar.

To sum up, trends at the industry level indicate a significant decline in the amount of capital available to America's workers. In other words, we have not made the productivity-enhancing investments necessary to maintain the Nation's industrial base.

As you are aware, the result of this for many U.S. industries has been nothing short of an economic disaster. If the 1970s trend continues, the international competitiveness of American industry will worsen. The pervasiveness of this decline is seen most clearly in the increasing influx of Japanese and German automobiles, French radial tires, Hong Kong textiles, Japanese television sets, Italian shoes and foreign bicycles, motorcycles, flatware and machine tools. I could go on. What we must recognize is that the major force driving this wave of foreign competition is productivity growth which is more rapid in these countries than in the United States.

What is needed at the industry level is a coherent set of policies designed to help companies in all industries modernize production facilities, hold down costs, and improve productivity. Instead of getting into the chancy game of picking winners or the costly game of propping up losers, the Government should try to create optimum conditions for stimulating productivity-enhancing investments. For the most part, the Administration's program is based on this concept. However, I believe the program should be supplemented by more specific initiatives directed at productivity improvement.

For example, it may be necessary to provide a special tax credit to get American companies to devote more resources to commercially oriented research and development. Because a macroeconomic policy will not benefit all industries equally, the Government also must improve its ability to analyze and predict the effects of these policies on particular industries.

Developing a policy to decrease investment barriers through accelerated depreciation, for instance, requires an understanding of which industries will benefit most from this policy and which require some other approach.

Our work at GAO identified three areas in which the Government can play a catalytic role in stimulating private sector productivity. These are

--increased adoption and diffusion of new technology,

--better utilization of human resources, and

--improved public/private sector cooperation.

In 1976, a GAO study entitled "Manufacturing Technology--A Changing Challenge To Improved Productivity" identified a number of efforts needed to further the development and acquisition of new technology. The report recommended the need to establish manufacturing productivity as a national priority and emphasized the importance of computer-integrated technology in improving productivity. GAO followed this report with studies on the coal and footwear industries. Each concluded that significant investment in productivity-enhancing technology is critical to the survival of the industry.

It concerns me that the Federal Government is still not doing enough to encourage the adoption and diffusion of new technology. A case in point is robotics--a technology that was developed in this country. We have been slow to apply this technology while the Japanese have moved rapidly ahead. A number of experts have testified before Congressional committees that Japanese firms are committed to increased reliance on robotics and automated manufacturing, not only as a way to improve product quality, but also as a means of improving productivity. To facilitate this trend, the Japanese Government employs a wide array of incentives to promote the growth of the robotics and machine tools industries. The results have been dramatic. The Organization for Economic and Cooperative Development recently reported that Japan commands 50-60 percent of the world market in computer numerical control tools and 60-80 percent of the world exports of these products; the Japan Industrial Robot Association has stated that Japan has 50,000 robots in operation, approximately six to seven times the number installed in the rest of the world.

For the U.S., robotics, computer controlled tools and related technologies hold the potential for significant increases in productivity, product quality, and the international competitiveness of U.S.-produced goods. GAO is now completing a study that will focus on Federal policies associated with extending robotics and automated manufacturing to batch processed manufacturing --an important area for future growth in manufacturing productivity.

The Government has made limited progress encouraging the diffusion of generic technology through the Defense Department's Manufacturing Technology Program and the Commerce Department's Cooperative Generic Technology Centers. The Defense program has grown significantly in recent years and, in many cases, has successfully stimulated the diffusion of productivity-enhancing technology among Defense contractors. On the other hand, the Commerce effort, which would have focused on commercial industries, never got off the ground. The centers, authorized in 1980 by the Stevenson-Wydler Technology Act, were eliminated under the President's Fiscal 1981 revised budget. I am not saying these two Government programs offer the key to technology adoption and diffusion--the programs are minuscule compared to similar programs established by our major foreign competitors. Furthermore, generic technology is only one among several Federal agency approaches designed to improve industry productivity. Nevertheless, generic technology programs, unlike many other Federal industry programs, offer potential productivity benefits which cut across the industrial sectors. These programs should be allowed to prove themselves and be accepted or rejected on their own merits.

We must continue to employ and evaluate specific mechanisms to encourage technology at the industry level. These mechanisms that prove ineffective should be eliminated; those that prove successful will supplement our macroeconomic efforts to improve productivity.

A second area where Government can be more effective is in utilization of human resources. The Federal Government spends billions of dollars every year on research, training, and education for public and private sector employees and potential employees. Few of these programs place any emphasis on their contribution to productivity improvement in the private sector. For example, as the manufacturing sector becomes more capital intensive through the use of technologies, such as robotics, the Federal role in retraining displaced workers must be addressed from a Government-wide standpoint. Similarly, defining the Federal role in encouraging labor-management cooperation to improve productivity is becoming increasingly complex and important. These issues, and most others in the human resources area, require that policy be developed in a comprehensive manner with the different needs of various industries taken into account. I hope very much that the proposed action to phase out the Labor Department's labor-management committee program in 1985 can be reversed.

A third area where Government action is highly important is to give higher priority to programs which have a favorable impact on private sector productivity. Strengthening of the public infrastructure can have important implications for productivity improvement. For example, our deteriorating mass transportation system and the decay of our highways and bridges can adversely affect the efficiency of workers in the work place. Budget policies are also involved where public investment can have a high multiplier effect on the private sector. We need to identify and support Federal investment programs which have such high multiplier effects by stimulating private investment. We also need to make certain that the Government support for basic research--so important for the long-term health of the economy--is adequate. Budget support for technology transfer programs, particularly in the space and defense programs, offers another high return for the tax dollar.

Overlaying all productivity issues, including the roles of technology and human resources, is the interdependence of Government and the private sector. Despite this interdependence, Government and the private sector seem at times to be increasingly at odds and to lack trust in one another. In this we differ significantly from other industrial nations with high productivity rates. While the basic adversary relationship between the sectors will always exist, we must work toward building into this relationship a sense of trust and cooperation.

To build this cooperative relationship, Government must take the initiative. There are some encouraging examples of efforts to provide public/private cooperation.

--In the area of capital investment, evidence points to an increased willingness on the part of the Government to work with the business community in addressing our national productivity problems. The passage of the Economic Recovery Act of 1981 encouraged capital investment through a reduction in the corporate tax rates, an improvement in the investment tax credit, and a reduction in the capital gains tax rate.

--In fiscal 1980, the National Science Foundation provided over $1.5 million for research in computer-aided design and manufacturing, artificial intelligence, and related computer areas. The Foundation plans to continue funding research in these areas as well as in tactile sensing and vision--needed for continued advances in computer integrated manufacturing technology.

--The National Bureau of Standards has been fostering the development of computer integrated manufacturing. The Bureau has been expanding its basic research programs and is planning to build a specialized computer manufacturing research facility.

--The Department of Energy has also established several cooperative projects which promise to improve coal extraction productivity. The Department is working with private companies to develop a shaft boring machine which will impressively reduce the time required to bring a mine into production.

--Another good example of growing public-private sector cooperation is the Steel Tripartite Committee. The Committee, composed of representatives from steel manufacturers, Federal departments, and the United Steelworkers of America, was established in 1978. Working groups addressed such productivity related issues as capital formation, trade, labor-management relations, and research and development. The Committee developed a series of recommendations for Government action, many of which have been accepted.

--One final example involves Government efforts to improve measures of productivity. In a 1980 report, GAO found that the private sector is interested in exploring ways of developing a new Federal productivity measurement program that would enable managers to assess their firm's productivity level and compare progress with that of similar firms. Such a program could be operated by groups of firms through arrangements with trade associations or similar organizations, with the Government acting as facilitator and advisor.

Cooperative efforts such as these are moves in the right direction--and more are necessary. Stated briefly: The Government must show a better appreciation of the importance of business to our economy by helping business remain strong and by finding ways to meet national objectives consistent with this need.

The private sector, in turn, must also be willing to work with the Government so public policy can be made with the insights of those the policies will affect. With better cooperation between the public and private sectors, the Federal Government can do much to help improve national productivity.

Productivity at the firm level

This brings us to the point where our productive base begins--the firm level. All our concerns about national productivity policy and industrial policy are designed to ultimately enhance the productivity of individual firms and the workers that make up those firms. At the firm level, it is up to individual managers to ensure that productivity and product quality are meeting international standards. The Government should support these efforts, but it cannot and should not be directly involved.

The importance of the individual manager and of the management philosophy at a given firm cannot be overestimated. For example, productivity statistics were recently calculated for 20 similar coal mines in Wyoming. Production, in terms of tons per worker day, ranged from 58 to 242. This wide variation in productivity was not the result of a different type of coal differing capital equipment, or varying Government regulations. The main difference was how company management worked with its employees. The most productive firm provided its employees with the greatest amount of individual responsibility and involvement in decisionmaking.

A 1981 GAO study on productivity sharing plans found that 36 firms with these plans had annual labor cost savings of over 16 percent. One of the biggest obstacles to the successful implementation of these plans was management resistance. It is clear that those managers willing to involve their workers in decisionmaking and productivity sharing are increasingly the most successful. This is an important part of the Japanese success story.

A GAO study of Japanese-managed firms in the United States and Japan identified a number of things Japanese managers do which many American managers do not appear to do as well. Each is believed to have an impact on productivity and quality--how great an impact is not known. For example, in Japanese-managed firms:

1. Strategic company planning looks at the next 5 to 10 years as short term and places heavy emphasis on a 10- to 20-year strategy. This single factor enables Japanese business managers to have an entirely different approach to quality in day-to-day operations than their American counterparts.

2. Product design and production process design are carefully integrated and tested to be absolutely certain a product can be made right the first time. Only then does full-scale production begin.
3. When a quality problem appears on the production line, the first person to spot the problem shuts down that line. The quality image is important enough to work over the weekend to catch up or even to deliver late on a contract. Americans have a great fear of shutting down a production line.
4. All employees, especially production line workers, participate in identifying and correcting production and quality problems. Quality Control circles are widely used. Americans often reserve this kind of problemsolving to production engineers.
5. Labor/management relations are harmonious largely because company financial and business information is freely shared with workers (whether or not unionized) so that everyone knows the sales and profit picture, the long-term company strategy and growth picture, and the investment and operating plans to carry out the long-term strategy.
6. With this kind of openness and with employees having a stake in company success, morale and motivation are extraordinarily high compared to many American firms.
7. Employees share in company profits, usually through semiannual bonuses. These often equal 20 to 40 percent of their normal salaries, which helps to explain the average Japanese personal savings rate of about 25 percent. The U.S. rate is less than 5 percent.

8. Information systems to identify progress and problems are highly favored by all employees. The aim is to correct any flaw as quickly as possible because everyone's success is affected.
9. Productivity and product quality are not viewed as tradeoffs. In fact, they are seen as interdependent. The Japanese view top quality as the key to opening the doors to worldwide markets, and poor quality as a sure way of having the doors slammed in their faces.

There are, of course, many other attributes to the Japanese approach to product quality which reflect sound management philosophy. The basic difference seems to be that the Japanese follow that philosophy relentlessly whereas the American short-term profit approach frequently invites expeditious solutions which ultimately can cause a company to lose the competitive race.

There is little that Government can or should do in this area, other than creating the kind of business environment that is at best conducive to long-term business thinking. The product quality ball is clearly in the private sector's court.

Pursuit of productivity gains will become a major management focus in the 1980s in both the public and private sectors. Falling birth rates since 1965 and the slowdown in the rate of entry of women into the labor force will provide strong incentives to substitute capital for labor, causing a major restructuring of jobs and the management functions associated with them. I would estimate that this will have its greatest impact in banking, insurance, public administration, and office work generally. A premium will be placed on the manager's role as an innovator and as a catalyst particularly in the growing information and service sectors of the economy.

In my statement today, I have placed particular emphasis upon the role of the Federal Government in stimulating private sector productivity. Much of what I have had to say also applies to the public sector--technology innovation, capital investments with high productivity improvement payoffs, the need for a top management commitment, and the development of programs for employee participation. One particular need is to provide for greater accountability as well as incentives for managers to improve productivity and reduce costs by letting them share in the results of productivity improvements. Such programs which have been initiated now in the Internal Revenue Service and in the Defense Department apply the same principle of cost-sharing which has been so highly successful in private industry. Within the Federal Government, this can be done by allowing the manager to utilize a part or all of the savings accomplished to meet other high priority needs, in his discretion. In this regard also we cannot overlook the great importance of individual and group recognition, including monetary rewards for outstanding work. These and other actions can be a part of a formal agency productivity improvement program, with the Office of Personnel Management and the Office of Management and Budget providing greater overall leadership, encouragement and assistance. It is particularly disappointing that the program initiated in 1979 by the Office of Personnel Management to assist Federal managers in productivity improvement has been virtually eliminated.

Conclusion

In conclusion, I want to emphasize that the current four-part approach to economic recovery--budget reductions, tax reductions, regulatory reform, and consistent monetary policy--is missing an equally important fifth prong: a targeted national effort to improve productivity.

We need a national productivity effort that is properly supported by the President and the Congress, involves the private sector, and is based on an agreed upon national productivity program. The goal would be to make sense of the numerous Federal policies and programs that affect productivity, and establish priorities for the changes that are needed to encourage productivity growth while meeting other policy objectives.

I sincerely hope that the apparent concern of numerous Members of Congress, the Administration, and the President about productivity improvement can be translated into a program of commitment and action. Legislation has been introduced in the Congress that would attempt to achieve what I am advocating, and I hope it will have your support.

Productivity growth has been a problem because it has been neglected. We have mistakenly believed it would take care of itself. It is time we faced up to the fact that productivity growth must be improved if we are to get inflation under control, improve our competitiveness in world markets, and maintain our standard of living. Productivity improvement is the "bottom line" on the Nation's economic balance sheet and should be treated as such at all levels of society.

Senator **Quayle**. Thank you, Mr. Staats, for your testimony. I can certainly concur with you that we have got to elevate the issue of productivity not only in our governmental policy but how we are going to improve it. That is one of the reasons that we wanted to have these hearings. They have been rather comprehensive. This is the concluding panel that summarizes many of the things that we have been discussing throughout the hearings lasting over 4 weeks.

I would like to just pick up, Mr. Staats, where you talked about the firm level and go back to Mr. Rose. You made a very excellent point that has not really been addressed by too many witnesses. That is, when you really talk about productivity, and perhaps more precisely the service industry, the way that it is going to improve and how it is going to be successful is the improvement of the human resources and the human capital. As Mr. Staats said, the real essence of productivity is going to be done at the firm level rather than some perhaps macroenvironment when you get right down to it. I wonder if you could tell this committee how you have utilized some of your employees in the participation of improving productivity. How do you go about getting this kind of interaction with your people on a human resource basis to have this competition within your business on the idea of improving productivity? Please share with us some of your thoughts, what in fact you do, where you have been successful.

Mr. **Rose**. Senator, at a hearing like this, I am afraid that what I am going to tell you will shock everyone because of its simplicity. The best thing we do to improve productivity at the human resource level is talk to our people. I know that that sounds awfully simplistic, but it is amazing how often management does not talk to the person who is doing the job. They design a job for that person. They put specifications on the desired output. They may measure the desired output to see if the job gets done the way they thought it should but they will never talk to the person who is actually doing the job to see whether that person can do more, do it better, do it faster. They never get input from the real expert on any job, the person who is doing it.

We came to that conclusion a long time ago. We have been working hard in communicating with our people who are doing the jobs to find out how they think the jobs can be done better and what kind of resources in terms of either capital resources or management techniques, labor scheduling, that we can bring to bear to make their lives easier so that they can produce more with less time or less effort.

Senator **Quayle**. In your discussions and communication, do you use the word productivity? Is this sort of a code word with the employees and within the management on how you go about and have this correspondence with your employees?

Mr. **Rose**. I think productivity is a word that gets used a lot. It also has a lot of negatives that go along with it. To a lot of lowest level, hourly workers the word productivity means job elimination because that is what has occurred in the past. In fact, that is what continues to occur. What management must do is to communicate not only along with the sense of what more they are going to ask employees to do but the fact that a secure future us assured if the employees accept the new challenge. So, productivity and job security are two words that must go hand in hand.

Senator **Quayle**. The word productivity, at least according to polling data, has changed remarkably in this country. If you go back 15 years, you mention the word productivity and they think of the Charlie Chaplin movie "Modern Times." The worker just worked harder. The harder that he or she worked, the more profitable the company would get. Now you ask that question—and I forget the data of the Lou Harris poll; it was 79 or something like that—70 percent or close to that feel that productivity, enhanced productivity also means an enhanced quality of life.

I certainly agree that the two interrelate, productivity and job security. But what I am trying to do is to take from a firm level and at your level and interrelate to how we are going to put this on a national scope and what Mr. Staats is talking about, on a national productivity council, and to see if that word productivity really ought to be the fifth prong that we talk about that is missing in our economic recovery plan. If it is, are you at the firm level, is this the word to use? Is it productivity? Or do you shy away a little bit from that because of the bad connotations it has had over the past?

Mr. **Rose**. What we obviously try to do is talk in terms of things like quality of work life. That is the buzz word that is currently fashionable. I think it does describe what we are actually trying to do. That is by getting more participation we get better quality of output from the workers.

In terms of a national posture, I find no objection to productivity. I think that it is becoming a word that has changed in the consciousness of people.

Mr. **Staats**. I would like to comment on that, too. I agree with that. The old connotation that it had, I think, has largely disappeared.

Senator **Quayle**. It has disappeared?

Mr. **Staats**. Yes.

Senator **Quayle**. At least the polling data shows that.

Mr. **Staats**. I do not have a complete inventory, but you will find a vast number of corporations now have set up top officers with that title. A great many of them do emphasize the quality of work life aspect of it. This symbolizes a change of attitude on the part of management, that they want to work with people. They want to communicate with them. They want a bottom-up/top-down type of management philosophy instead of just a top-down philosophy.

The other reason I think it has changed is because of foreign competition. The worker realizes that he is in a world market. If he does not improve his quality of his product and lowers the cost of that product, then he is going to be out of a job. I think Japan and Germany's experience here and other countries' experience here has done a lot by the publicity that it has received. It has done a lot to remove that old connotation.

Senator **Quayle**. I spoke a few months ago to a corporation and they had the hourly employees and the management there. They had productivity teams. Productivity was the big code word. This was in manufacturing rather than service. I was really amazed. They wanted me to talk on productivity, as a matter of fact. I started to do some work and found out that this had really become more or less an accepted word of improvement of one's standard of living for everyone. I was a little bit surprised on how readily acceptable it was.

Mr. **Staats**. We have very top-level labor representation on the board of directors of the American Productivity Center. The point they do emphasize is "let's talk about total factor productivity, not just worker output." That is something very different. It is more difficult to measure. I suppose that is the reason the BLS does not use it. But it is real in the sense that you are talking about investment. You are talking about technology. You are talking about capital improvements. You are talking about improved management processes. You are talking about a lot of things other than just making the worker work harder.

Senator **Quayle**. Mr. Campbell, do you know off the top of your head what percentage of our exports are service-related exports?

Mr. **Campbell**. You have that in your paper.

Mr. **Rose**. The figure that I quoted in my testimony was 17 percent of our exports are service exports and that 20 percent of world trade is now in the service sector.

Senator **Quayle**. Twenty percent.

Mr. **Campbell**. That is an increase.

Senator **Quayle**. Yes. You say that West Germany and Japan are now net importers?

Mr. **Campbell**. Importers. That is correct.

Senator **Quayle**. What could we do to increase the exports of our services? Are there a couple of specifics that we could do in this area that would really focus right in to show as a priority as far as growth? And we are all looking at exports in this day of huge imports and where we could be going and what could be achieved.

Mr. **Campbell**. The Coalition of Service Industries, which I mentioned is in the process of being formed, does have a fairly complete program which they, by the way, have provided to Trade Representative Brock which, hopefully, will get on the table in the negotiations.

Senator **Quayle**. Would they be willing to submit that to us?

Mr. **Campbell**. I am sure they would.

Senator **Quayle**. I would like to have it for further reference.

Mr. **Campbell**. I will mention a couple of quick things. In some cases, for example, there is an absolute prohibition on a service being delivered in a foreign country. For example, I believe it is one of the Scandinavian countries that does not permit American insurance companies to participate at all in the insurance business in that country.

Second, there are a variety of requirements which require local participation in joint ventures that hinder the ability of American service industry to get involved.

There also are difficult controls in the currency area which particularly impact companies that are in the financial services side of the business.

The list is a long one. I will have that provided for the record.

Senator **Quayle**. I would certainly appreciate it because I think this is an area not only of concern but one of potential growth that we could have.

I wonder, Mr. Campbell, if you could tell me once again what your opinion is on why OPM eliminated this productivity improvement situation?

Mr. CAMPBELL. I am not privy to internal discussions.

Senator QUAYLE. I know that.

Mr. CAMPBELL. But I can tell you by observing from the outside that with the cutback in resources that OPM and other Government agencies have all experienced some hard decisions internally about where priorities should be placed. The outcome of those decisions in OPM was to stress what I call the regulatory side of the central personnel agency, the police side, of making sure that all the rules and regulations are followed. That was emphasized. As a result of that, there simply had to be cutbacks in other parts of the agency. The work force effectiveness and development group, which has responsibility for the productivity improvement program, as a result has its budget cut back very, very substantially.

Mr. STAATS. I made reference to this also, Mr. Chairman. I would add another point. The administration properly is concerned with cost of Government and getting the budget reduced. Over a period of time, a program of this type can have high payoff in that respect in the Government itself. The GAO has done some excellent work and continues to do good work, but the OPM is in a position where it is a part of the executive branch and represents the President in this field. I think it was a mistake in terms of priorities to cut that program out.

Senator QUAYLE. Mr. Staats, on this National Productivity Council, I believe you talked about the Director having to be confirmed by the Senate to try to give it a high profile. What kind of influence and scope of responsibility should this council have in coordinating activities in the area of productivity, to deal with direction of research and development funds? What are we really talking about as far as true influence and scope of responsibility of this, to get to your fifth prong?

Mr. STAATS. That is a good question. I think the key to it is have a senior officer of the Government who has the sole concern of calling attention to what needs to be done on every front, public and private, to enhance productivity in this country. I think he can do that only where the Congress itself is a party to the action in terms of not only confirming the appointment but also in the charter which he has. It needs to be a person who has access to the very top levels in the executive branch and who can appear before the committees of Congress, whatever committee may have responsibility for parts of the total program. It would be his job to get out and make speeches. It would be his job to call together labor and management around the table and see where the inhibitions are and what needs to be done, what can be done. It is not necessarily all by the Federal Government. He can do a great deal by way of public education as to what needs to be done.

I refer to it as a productivity plan or a program. I notice you use the word strategy. I would be quite willing to use that also.

We have bits and pieces of this program all over the Government. You have the question of regulations. You have the question of technology transfer. You have got patent policy which was referred to this morning. There are dozens of elements which go into what I would call a national productivity program.

Senator QUAYLE. These elements like the patent applications, and enhanced research and development, would they be under the jurisdiction of this commission as such? Or would this commission have access to that and then work with the administrative head of that particular agency?

I am trying to get a fix on how we legitimize and enhance the credibility and the status of this council to achieve what you want to do. If you are talking about a fifth prong, that is a very major element. It is going to have to be a fairly comprehensive and major piece of legislation and decision by the Congress and the President. That is what I am trying to arrive at, this instant status that we might be able to achieve by doing this.

Mr. STAATS. I think Senator Bentsen's bill, S. 489, which he introduced February 17, 1981, pretty well reflects what I am talking about.

Senator QUAYLE. Does Japan or do any other countries have a council like this?

Mr. STAATS. Every industrialized country in the world has something of this type.

Senator QUAYLE. And we do not?

Mr. STAATS. And we do not.

Senator QUAYLE. That is somewhat of a self-indictment of the whole issue that we have been discussing.

Gentlemen, I certainly appreciate your fine testimony. I look forward to working with each of you in the future.

If you would be willing to submit that to us, Mr. Campbell, we would certainly appreciate it.

Mr. CAMPBELL. I will.

Senator QUAYLE. I could not think of a better group to conclude our hearings. I am deeply indebted to all of you. Thank you very much.

[Additional information supplied for the record follows:]

COMMITTEE FOR ECONOMIC DEVELOPMENT

The Future Role of Manufacturing and Service-Type Industries in the Economy: Implications for Productivity Policy

by

Kenneth McLennan
Vice President and Director of Industrial Studies
Committee for Economic Development

Submitted for Productivity Hearings
May 1982

SUBCOMMITTEE ON EMPLOYMENT AND PRODUCTIVITY

UNITED STATES SENATE

The views expressed in this paper are those of the author and are not necessarily shared by the trustees of the Committee for Economic Development. The author wishes to acknowledge the research assistance of Patricia Buckley and Lorraine Brooker.

Over the past two decades service-type industries have increased in importance in the U.S. economy. More Americans are now employed in providing a wide variety of services and more of our Gross National Product is now attributable to services -- 57 percent of our GNP is produced in wholesale and retail trade, finance, real estate and insurance, business and personal services and in government. It is therefore important to pay greater attention to improving productivity in these service-type sectors of the economy, as proposed in recent testimony before the Subcommittee on Employment and Productivity.[1] It is also important for the U.S. to negotiate international trading agreements so that the U.S. can benefit from its apparent comparative advantage in trade in some service. However, in advocating these desirable policy goals many political and business leaders overestimate the magnitude of the structural shift which has occurred and underestimate the future importance of manufacturing in the U.S. economy.

I. Past Structural Shifts to Service-Type Industries Have Been Modest and Not at the Expense of Manufacturing Output

As shown in Table I, the output of service-type industries now account for about 57 percent of our GNP. This represents a small one percentage point

---

[1] See testimony of Alan K. Campbell on "Productivity Improvement in the Service Sector: The Public Sector's Role," before Senate Subcommittee on Employment and Productivity, April 16, 1982.

Table I

Real Value Industry Outputs as Percent of Real GNP

Year	Agriculture, Forests and Fisheries	Mining	Construction	Manufacturing	Transportation and Public Utilities	Wholesale and Retail Trade	Finance, Insurance and Real Estate	Services	Government
1960	4.4	1.8	6.3	23.3	7.8	15.9	13.9	11.3	14.6
1961	4.2	1.8	6.2	22.7	7.7	15.7	14.2	11.4	14.8
1962	4.0	1.7	6.0	23.3	7.7	15.8	14.2	11.3	14.4
1963	3.9	1.7	6.0	24.3	7.8	15.7	14.0	11.3	14.3
1964	3.6	1.7	6.0	24.7	7.8	15.9	13.9	11.3	14.0
1965	3.5	1.7	5.9	25.5	7.9	15.9	13.8	11.1	13.8
1966	3.2	1.7	5.5	25.9	8.1	15.9	13.6	11.1	13.9
1967	3.2	1.7	5.3	25.1	8.1	15.8	13.8	11.4	14.2
1968	3.0	1.7	5.4	25.3	8.3	16.1	13.8	11.2	14.1
1969	3.0	1.7	5.1	25.5	8.5	16.0	14.1	11.4	14.0
1970	3.2	1.7	4.9	24.1	8.7	16.2	14.4	11.7	14.1
1971	3.2	1.6	5.2	23.8	8.7	16.5	14.5	11.4	13.7
1972	3.0	1.6	5.0	24.7	8.8	16.8	14.3	11.5	13.1
1973	2.8	1.5	4.8	25.9	8.8	16.8	14.1	11.5	12.5
1974	2.9	1.5	4.3	25.0	9.0	16.6	14.8	11.9	12.9
1975	3.0	1.5	3.9	23.5	9.2	17.0	15.2	12.0	13.3
1976	2.8	1.5	4.1	24.4	9.1	16.9	15.0	11.9	12.7
1977	2.7	1.4	4.0	24.7	9.1	16.8	15.2	11.8	12.3
1978	2.6	1.4	4.1	24.8	9.3	16.8	15.2	11.9	12.0
1979	2.7	1.4	3.9	24.8	9.5	16.7	15.3	12.0	11.8
1980	2.7	1.5	3.7	23.7	9.7	16.4	16.0	12.4	11.9

Source: Economic Report of the President, February 1982, p. 245.

increase since 1960 when these same sectors accounted for 56 percent of GNP. Even if transportation and public utilities are classified as service, the 20 year change only represents an additional two percentage point shift toward service-type industries.

The growth within this rather extensive definition of service was as follows: There was a slight growth in the share attributable to business and personal service (one percentage point); to finance, real estate and insurance (4 percentage points); to transportation and public utilities (2 percentage points). This increase in the share of output in some service-type industries is entirely consistent with the growth of income for some population groups. These proportionate increases were, however, at the expense of the government services as well as agriculture, mining and construction sectors -- not manufacturing. Indeed, manufacturing share of GNP was about the same in 1980 (23.7 percent) as in 1960 (23.3 percent).

A similar conclusion can be drawn from examining the value of goods and services purchased by final users. By this measure "goods" have declined proportionately but still account for about 43 percent of demand by final users. Table II shows that the growth in output of manufacturing has been similar to growth rates in service-type industries.

I do not believe data problems would have any important effect on these trends, even though these data are based on estimates and not all of them are compiled by establishment. In all cases an attempt is made to allocate

Table II

Real Annual Rates of Growth of Industry Sectors

Years	Agriculture, Forests and Fisheries	Mining	Construction	Manufacturing	Transportation and Public Utilities	Wholesale and Retail Trade	Finance, Insurance and Real Estate	Services	Government
1960-65	0.4	3.1	3.4	6.6	5.0	4.8	4.6	4.3	3.5
1965-70	1.0	3.8	-0.4	2.0	5.3	3.5	3.9	4.2	3.7
1970-75	1.5	0.0	-2.0	2.1	3.6	3.5	3.8	3.2	1.4
1975-80	1.6	3.2	2.4	3.9	4.9	3.0	4.7	4.3	1.4

Source: Economic Report of the President, February 1982, p. 245.

output among type of activity and there is no evidence that the bias favors either manufacturing or service-type output.[2]

Overemphasis on the employment changes as an indicator of a structural shift away from manufacturing is why many political and business leaders often exaggerate the trend toward a service economy.[3] While manufacturing employment in absolute terms remained almost constant in the seventies, this sector's share of total civilian employment has declined from 26.4 percent in 1970 to about 22.2 percent in 1980.

Over the same period there was also a significant decline in the relative importance of agriculture as a source of employment. The largest increase in employment growth occurred in several service-type industries (wholesale and retail trade, finance, insurance and real estate, and business and personal services) as their share of civilian employment increased from about 50 percent in 1970 to 55 percent in 1980.

The relative decline in manufacturing employment is attributable to higher productivity growth in manufacturing as well as gradual changes in demand. Labor markets readily adjusted to this structural change. The growth of the labor force was absorbed into expanding industries, many of which probably had a high proportion of what might be loosely described as service-type jobs.

---

[2] Even though it is difficult to adjust manufacturing output for quality changes, it may be more difficult for services. This leads to larger errors in estimates for some services.

[3] The predominant structural shift during the seventies was probably a reallocation of resources within both the manufacturing and service sectors. According to a paper prepared for CED's forthcoming policy statement on industrial strategy and trade, this reallocation of resources made a substantial contribution to aggregate productivity, which was offset by other factors, such as lack of capital formation, etc. See, Gollop, Frank M., "Evidence for a Sector-biased or Sector-neutral Industrial Strategy: Analysis of the Productivity Slowdown," forthcoming 1982.

II. Both Manufacturing and Services are Essential to Future of U.S. Economy

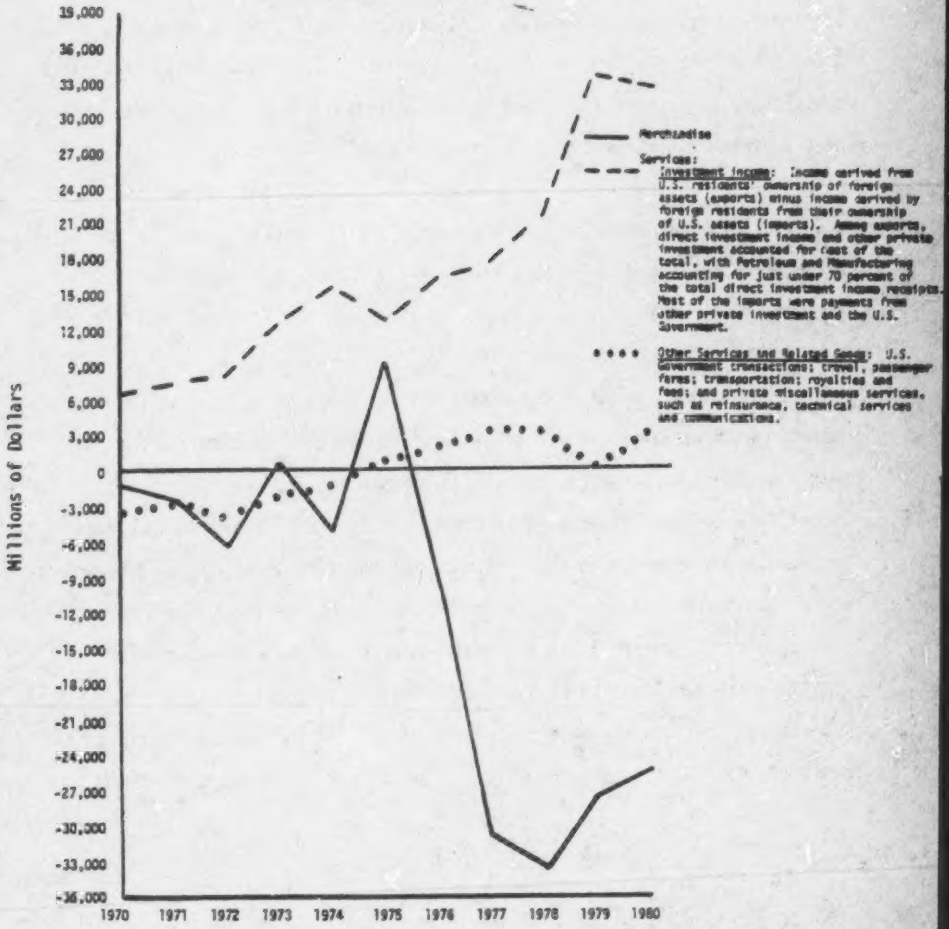
Those who predict, or even advocate, that in the future the importance of manufacturing will decline and, that we must accept the fact that our comparative advantage as a nation will be in the provision of services, are doing policymakers a disservice. In support of such a substantial structural change they argue that our future export potential is in services because services have achieved a large net balance, large enough to offset the deficit in merchandise trade during the past decade. It is true that our merchandise trade position has weakened seriously since the mid-seventies but the positive balance in "services" is largely attributable to the earnings from U.S. investments overseas. Indeed, other "services" have only had a small positive balance since the mid-seventies.

Those who argue that we have a large positive balance in services lump "investment earnings" and other services together despite the fact that most investment earnings have little to do with the "service industry." Indeed, almost 70 percent of investment earnings come from U.S. investment overseas in petroleum and manufacturing. As shown in Chart I, when investment earnings are excluded from the broad definition of services, the contribution of other service exports to a positive U.S. balance of payments is quite modest.

The contribution of all sectors to the U.S. balance of payments is important, but it should be clearly understood that in 1980 exports of goods accounted for about 65 percent of the value of all U.S. exports, even when

Chart I

BALANCE ON GOODS AND SERVICES
(Exports minus Imports)



SOURCE: Adapted from Anthony J. DiLullo, "Service Transactions in the U.S. International Accounts, 1970-80," Survey of Current Business, November 1981, p. 30.

BEST COPY AVAILABLE

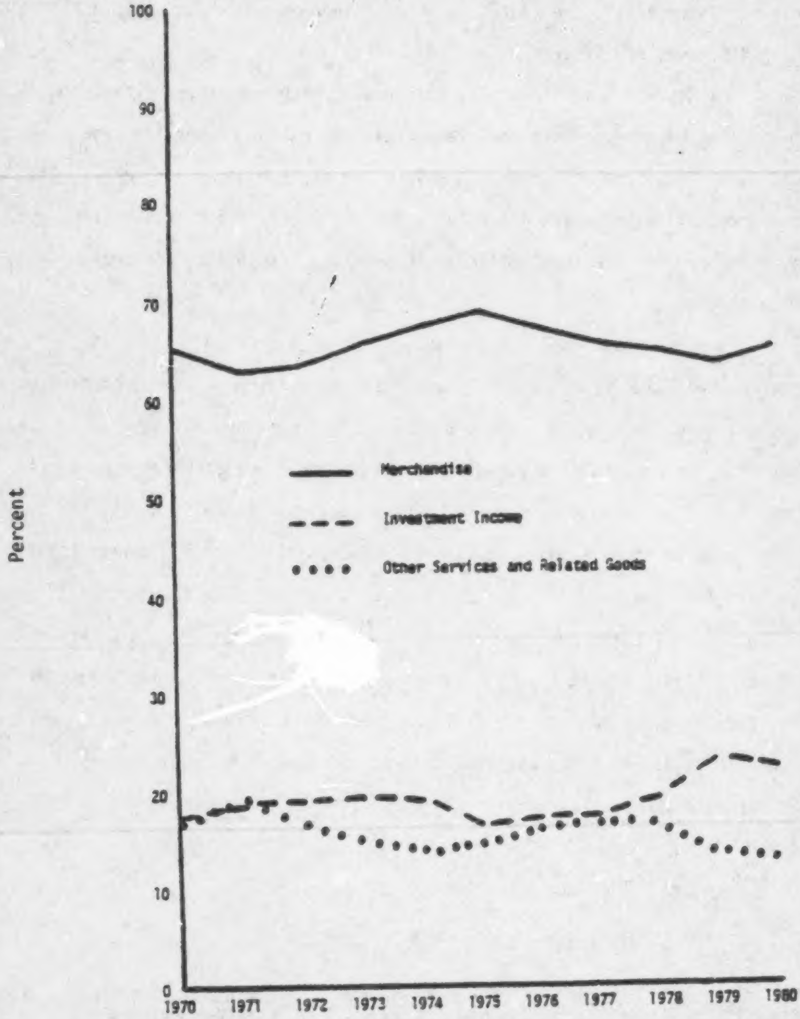
investment income is included in exports. This percentage has remained the same since 1970. As shown in Chart II, the proportion of receipts from investment earnings has increased from 17.9 percent to 22 percent of exports of goods and services. In contrast, the contribution of "other services" actually declined from 17.4 percent of 13 percent in 1980.

Policymakers should, in my opinion, be skeptical about optimistic claims of the benefits of further structural changes toward service-type industries. Since the U.S. does not have a comparative advantage in all types of services, it is important not only to improve productivity in services, but also to improve the treatment of trade in services within international trading agreements.

Any reduction in the contribution of manufacturing to the U.S. GNP may affect the value of exports in goods. If our ability to export goods is reduced, a sound balance of trade position would depend heavily on a substantial increase in exports from investment earnings and/or other services. Growth in the receipts from foreign investments depend partly on the U.S. ability to reinvest receipts from a positive balance in merchandise trade. Unless the U.S. is able to increase manufacturing productivity, and maintain this sector's contribution to GNP the positive balance from receipts from foreign investments could be seriously eroded in the future. Consequently, past trends in exports do not provide any grounds for optimism. Given the consistently important role of trade in goods, it seems unlikely that an increase in "other services" could offset a substantial decline in the proportion of manufacturing to GNP.

Chart II

PERCENT CONTRIBUTION OF SECTORS TO EXPORTS OF GOODS AND SERVICES



SOURCE: Adapted from Anthony J. DiLullo, "Service Transactions in the U.S. International Accounts, 1970-80," Survey of Current Business November 1981, p. 30.

Public debates over whether services or manufacturing should be the future base on which to build the U.S. economy are counterproductive. My personal prediction is that the manufacturing sector as a source of employment will decline relatively in the eighties, as the past trend in capital investment in this sector is reversed. Consequently, employment in manufacturing as a share of civilian employment will decline further. There will also be structural shifts in employment within manufacturing.

Structural change is beneficial provided resources move toward their most productive use. There is good reason to believe that these uses will continue to be in industries within manufacturing as well as services. In the future, public policy should encourage structural change in both services (through application of micro processors, etc.) and manufacturing (through robotics and genetic engineering, etc.). In addition to raising productivity through the application of new technology and better quality of output, we must lower our unit costs of production through improved personnel and industrial relations practices in all industries. Such changes are essential so that both sectors can continue to contribute to improvement in the standard of living of future generations.

Senator QUAYLE. The meeting is adjourned.

[Whereupon, at 12:28 p.m., the meeting was adjourned.]

○